Brüel & Kjær

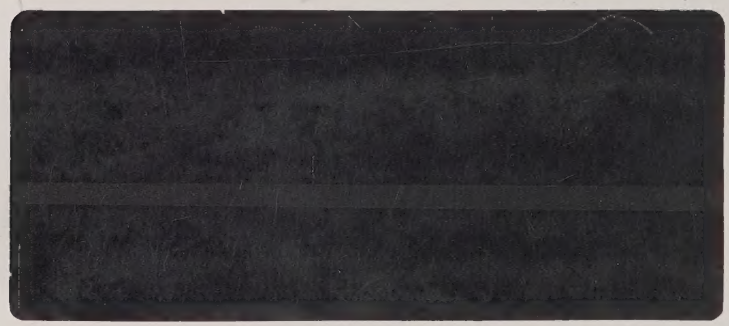
1623

Tracking Filter

Valid from serial no. 725659

037–0301

Service



1623

Tracking Filter

Valid from serial no. 725659

037—0301

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Spare Parts

Please state type and serial number of the instrument when ordering spare parts.

Trouble Shooting

If any fault should occur, check the instrument according to the checking procedure.

The Checking Procedure is divided up into sections, where each section will refer to a subsection in the Service Instruction corresponding to a specific part of the instrument.

The subsection in the Service Instruction will normally consist of a block diagram, a technical description, an adjustment procedure and a simplified diagram where the test points are identified.

Before correcting any apparent deviation make sure that the measuring instrument has tolerances small enough not to affect the measurement.

When a fault has been traced and corrected, the voltages and adjustment influenced by the correction must be rechecked. The complete instrument should then be tested to make sure that all basic functions are operative.

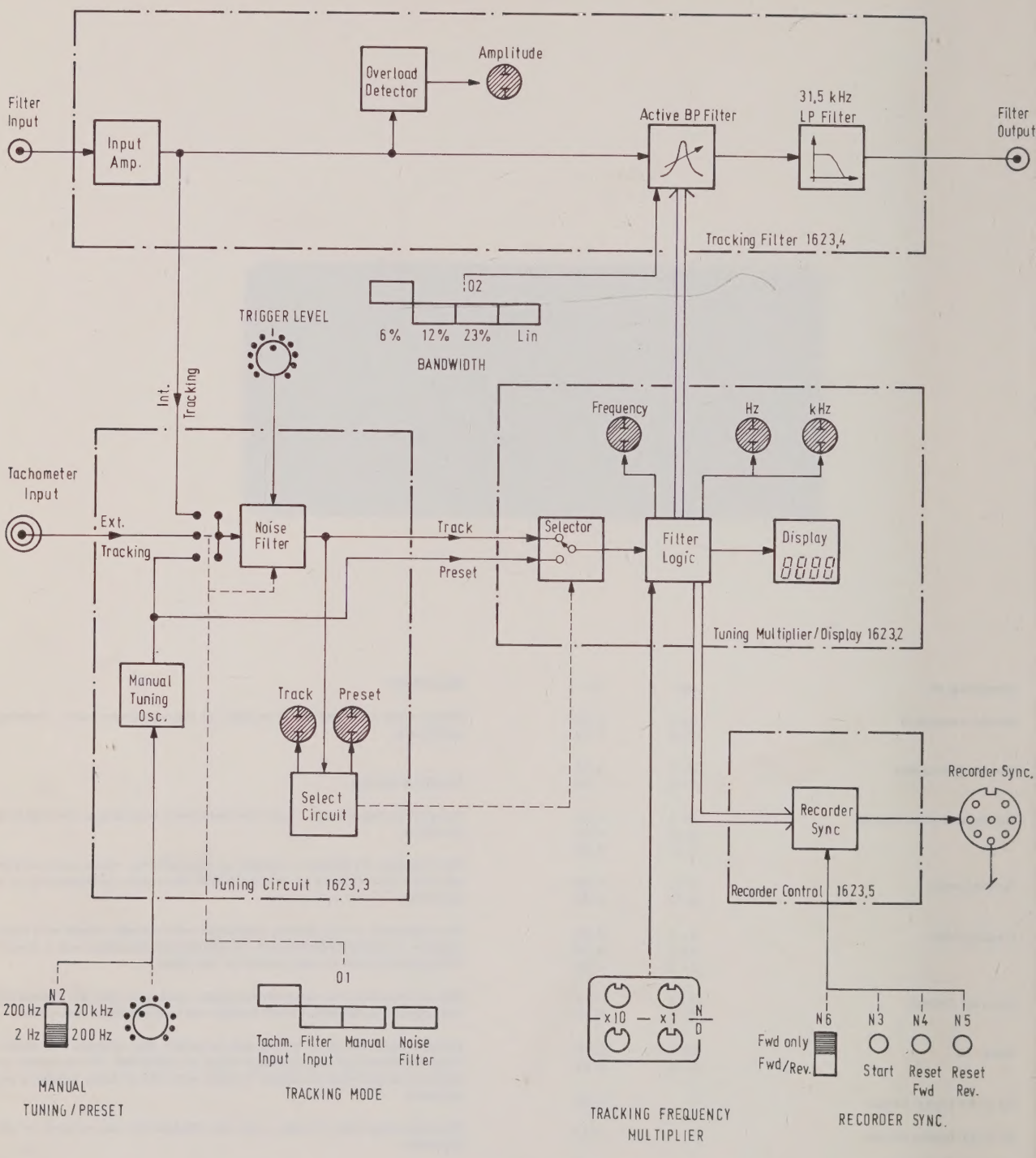
The tolerances given in these notes are intended for use as guide for adjustments.

Updating

Due to the constant progress in technology the instrument will from time to time be brought up to date in order to provide continously improved performance.

For this reason there may be small variations between the instrument and the Service Instruction.

However, the local Service Representative is in possession of all informations regarding any change that has been made.



Power Supply
See Tuning Multiplier/Display
1623,2

The battery operated, Tracking Filter Type 1623 is a narrow bandwidth digitally tuned analog filter whose center frequency automatically locks onto and follows the fundamental frequency, or a harmonic, from 1/99-99, of a periodic tuning signal originating from, for example, a tachometer or vibration transducer.

1.1 Manual Tuning

a. BATTERY: "On"
MANUAL TUNING/PRESET: "2 Hz — 200 Hz"
TRACKING MODE: "Manual"
BANDWIDTH: "Lin"
TRACKING FREQ. MULTI.: $\frac{N}{D} = \frac{"01"}{01}$
MANUAL TUNING: "Fully counter clockwise"

No input connected.

Check the "Battery" indicator. The pointer should be in the green area.
Check indication: "Hz" and "Track"
"Filter Center Frequency": 2,05 Hz ± 0,02 Hz

b. MANUAL TUNING to "Fully clockwise"

"Filter Center Frequency" indication: > 200 Hz

c. MANUAL TUNING/PRESET to "200 Hz — 20 kHz"
MANUAL TUNING to "Fully counter clockwise"

"Filter Center Frequency" indication: < the frequency found under item 1.1b.

d. MANUAL TUNING to "Fully clockwise"

"Filter Center Frequency" indication: > 20 kHz
Out of range indication "Frequency" flickers.

e. MANUAL TUNING to approx. "20 kHz"

Out of range indication "Frequency" stop flickering.
In case of malfunction consult 1623.3

f. MANUAL TUNING to approx. "2 kHz"

Check that indication "Hz" and "kHz" shift takes place at approx. 2 kHz.
In case of malfunction consult 1623.2

1.2. Filter Bandwidth

BATTERY: "On"
MANUAL TUNING/PRESET: "200 Hz — 20 kHz"
TRACKING MODE: "Manual"
BANDWIDTH: "6%"
TRACKING FREQ. MULTI.: $\frac{N}{D} = \frac{"01"}{01}$

Input signal to "Filter Input": approx. 1 V RMS 1 kHz.
Turn MANUAL TUNING to approx. 1 kHz.
Fineadjust input frequency for max. voltage on "Filter Output". Fineadjust input voltage to exactly 1 V RMS on "Filter Output", for each BANDWIDTH position.
Check the BW_{3dB} and insert the frequency values for f_{upper} and f_{lower} into the formula below, and calculate the bandwidth percentage.

NOISE
BANDWIDTH BW_{3dB} (%)

$$\left.\begin{matrix}6\\12\\23\end{matrix}\right\} \Rightarrow \frac{(f_u - f_l) \times 100}{\sqrt{f_u \times f_l}}\% = \begin{cases}5{,}2 - 5{,}6\\10{,}4 - 11{,}2\\20{,}9 - 22{,}5\end{cases}$$

In case of malfunction consult 1623.4

1.3. Octave Selectivity

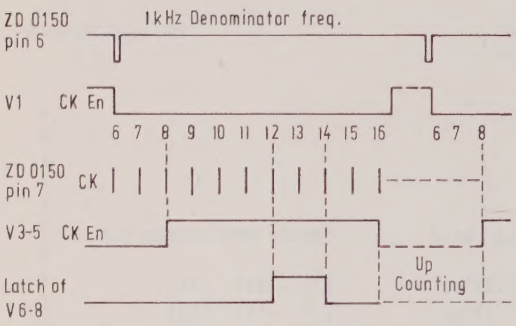
BATTERY: "On"
MANUAL TUNING/PRESET: "200 Hz — 20 kHz"
TRACKING MODE: "Manual"
BANDWIDTH: "6%"
TRACKING FREQ. MULTI.: $\frac{N}{D} = \frac{"01"}{01}$

Input signal to "Filter Input": approx. 1 V RMS 1 kHz
Turn MANUAL TUNING to 1 kHz ± 10 Hz. Fineadjust input frequency for max. voltage on "Filter Output". Fineadjust input voltage to exactly 1 V RMS on "Filter Output", for each BANDWIDTH position
Check the attenuation on "Filter Output" according to the table below.

	Signal frequency (Hz)	
BANDWIDTH (%)	500	2000
6	—57,5 dB	—57,5 dB
12	—45,5 dB	—45,5 dB
23	—34,1 dB	—34,1 dB
Tolerance (dB)	± 1	± 1

In case of malfunction consult 1623.4

Technical Description



Sequence Counter V1

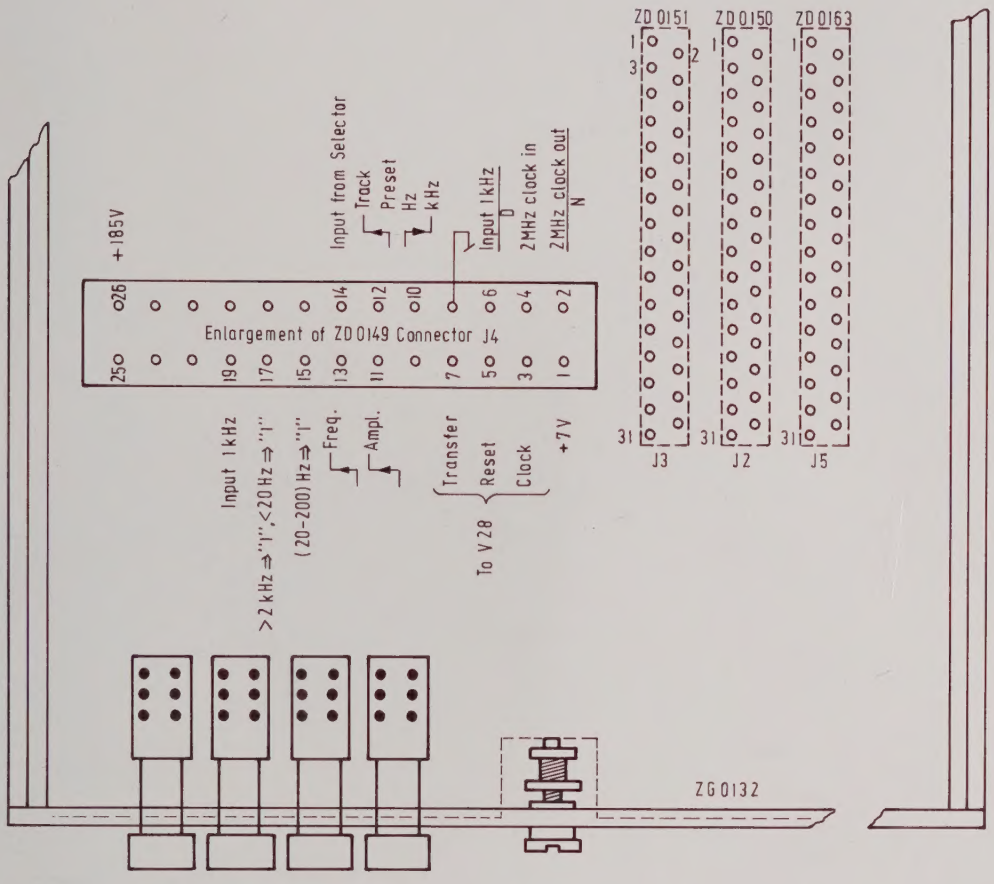
The Sequence Counter controls the Periode Upcounter and the Latch.
The Sequence Counter, is preset to 6 from it's own carry out and, starts counting on the first Numerator pulse (ZD 0150 pin 7) followed after CK enable, caused by the Denominator pulse (ZD 0150 pin 6).
Count no. 12, 13 latches the data from the Periode Upcounter into V6, 7, 8 from where it is taken to the Display.

Display Counter

The Display Counter V9, 10, 11 is preset to the input value and counts down clocked by the 2 MHz osc. The carry out is fed to the Counter/Display Decoder V28 clock input. V28 counts up in the periods of 0,1 s given by the Timing osc., adjustable by P1 on ZD 0151.

V18D gives on output a delayed Reset for V28.
This Reset must be delayed at least one Count Input pulse to V28.

The Count Input negative edge must follow a Transfer command before a Reset is applied to prevent transfer of invalid data.



Adjustment

2 MHz Osc.

Check that the Clock Osc. frequency is exactly the frequency written on the shield of ZT 0052.
If necessary adjust L1 on ZD 0150.

BATTERY: "On"
TRACKING MODE: "Tachm. Input"
TRACKING FREQ. MULTI: $\frac{N}{D}$ = "01"
BANDWIDTH: "6%"

If a component in the filter circuit has been replaced, check the following.
Input signal to "Filter Input" 220,0 Hz 1 V_{RMS}.
Input signal to "Tachometer Input" 211,2 Hz to 229,1 Hz 1 V_{RMS}.
Check that the filter attenuation is the same at 211,2 Hz as at 229,1 Hz.
If necessary adjust L1 on ZD 0150, and mark the new Clock. Osc. frequency on the shield of ZT 0052. Check the upper and two lower decades of the frequency range.
Max. difference between the input freq. and the displayed freq. ± 1,5%.

Display

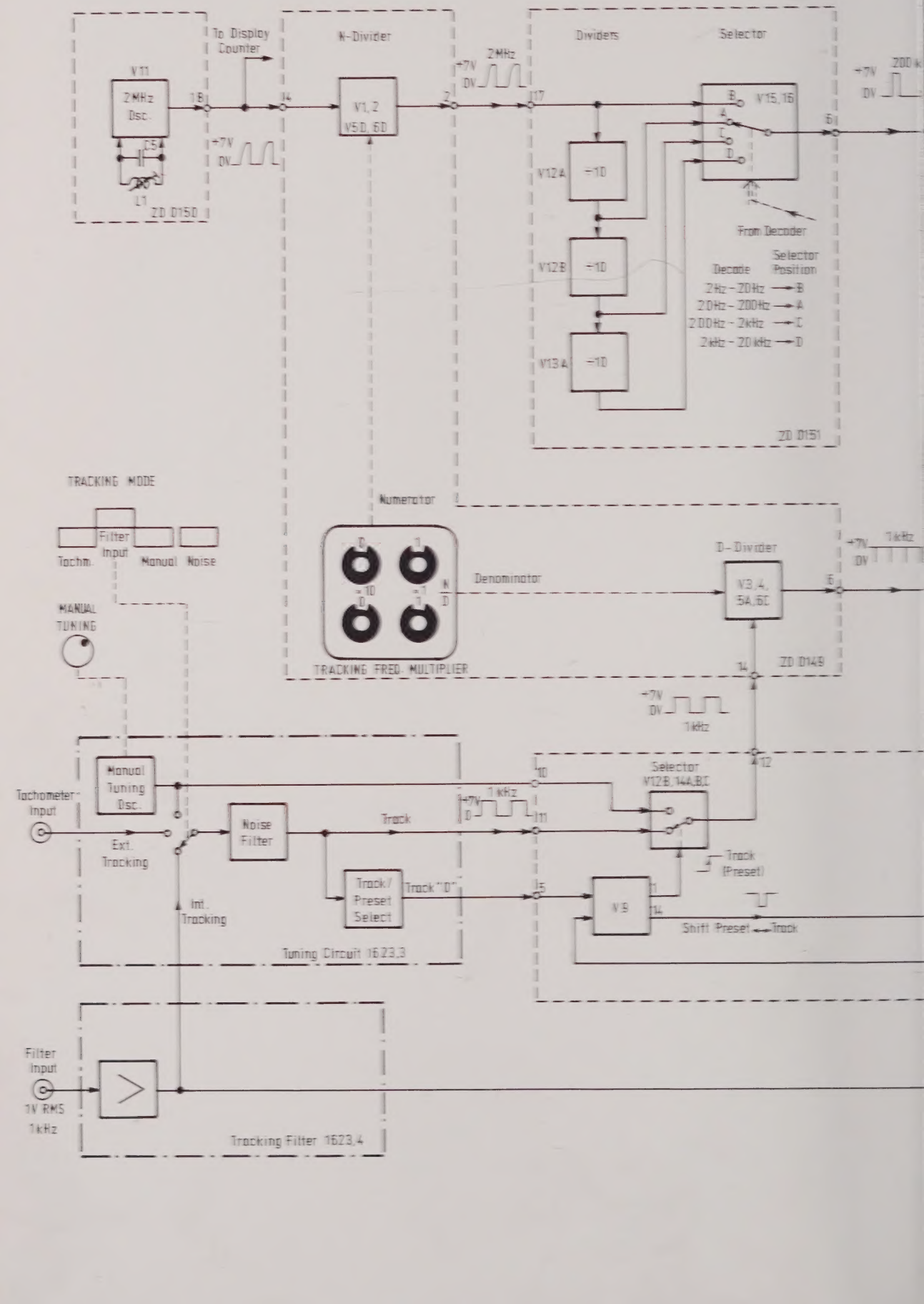
BATTERY: "On"
TRACKING MODE: "Filter Input"
TRACKING FREQ. MULTI: $\frac{N}{D}$ = "01"

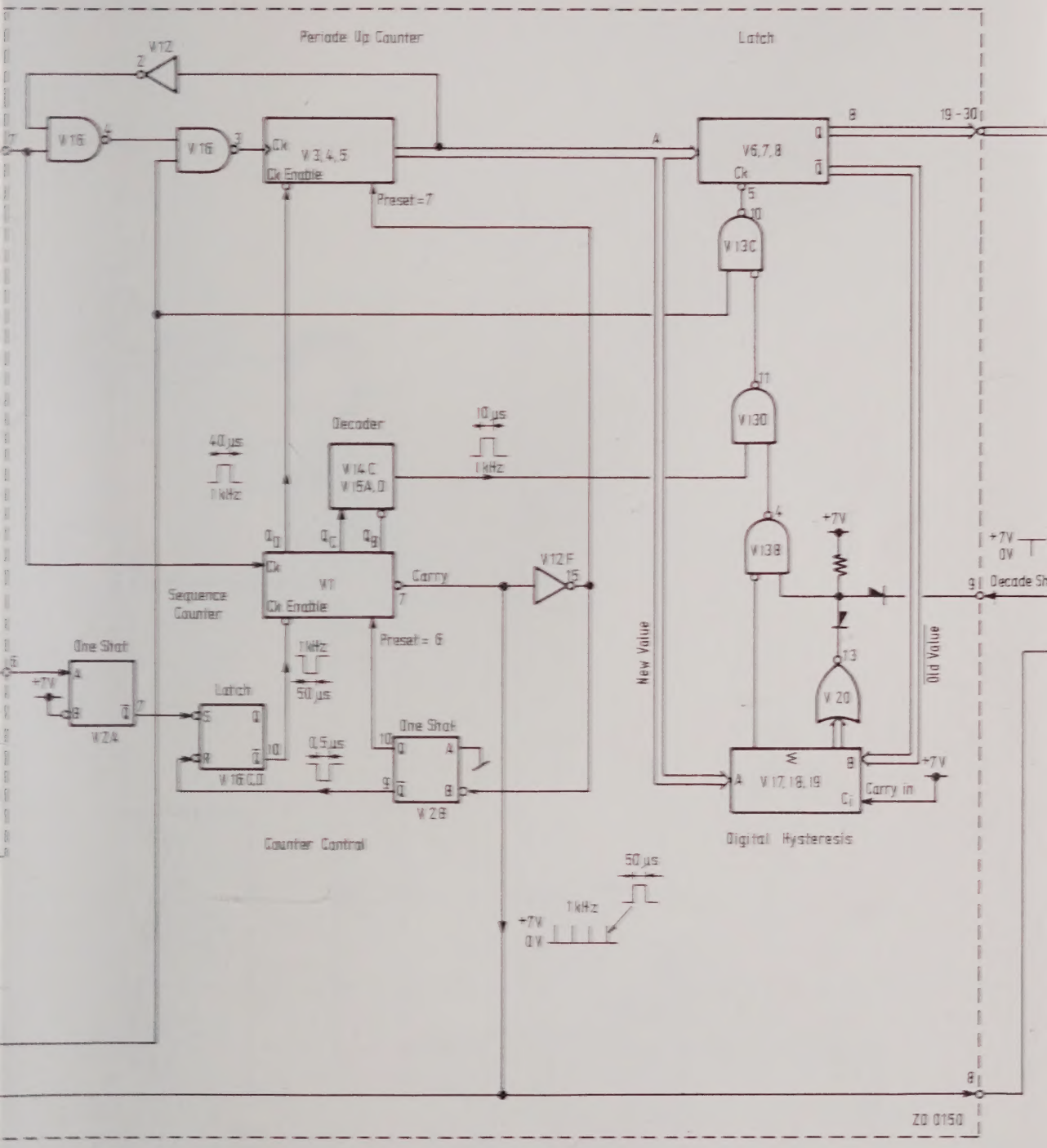
Input signal to "Filter Input" 220,0 Hz 1 V RMS.
Check that the "Filter Center Frequency" Display shows 220 Hz ± 2 Hz.
If necessary adjust P1 on ZD 0151.

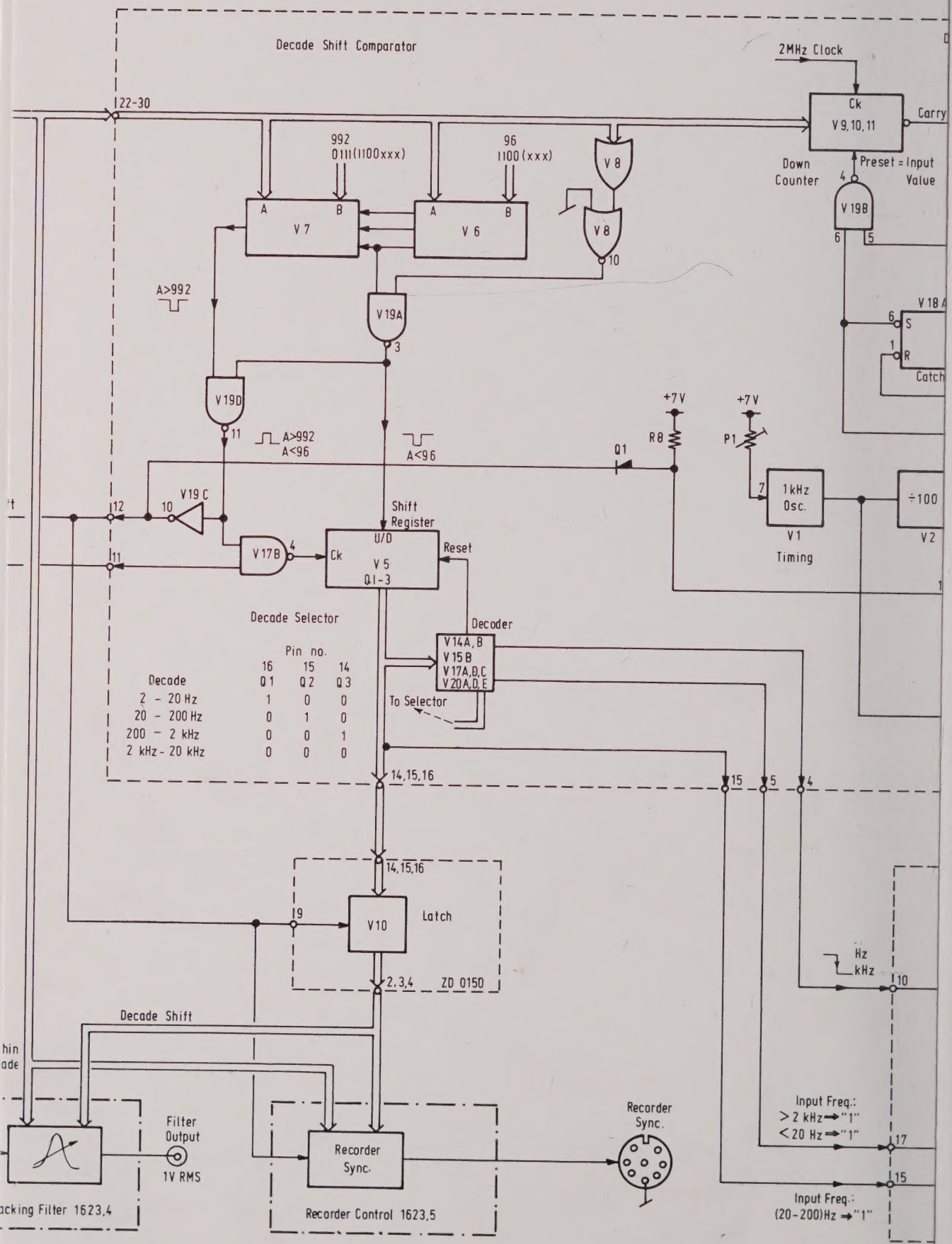
Change input frequency to 180 Hz.
Max. difference between "Filter Center Frequency" Display and input frequency, when the input frequency is changed is 1,5%.
If necessary readjust P1 on ZD 0151.

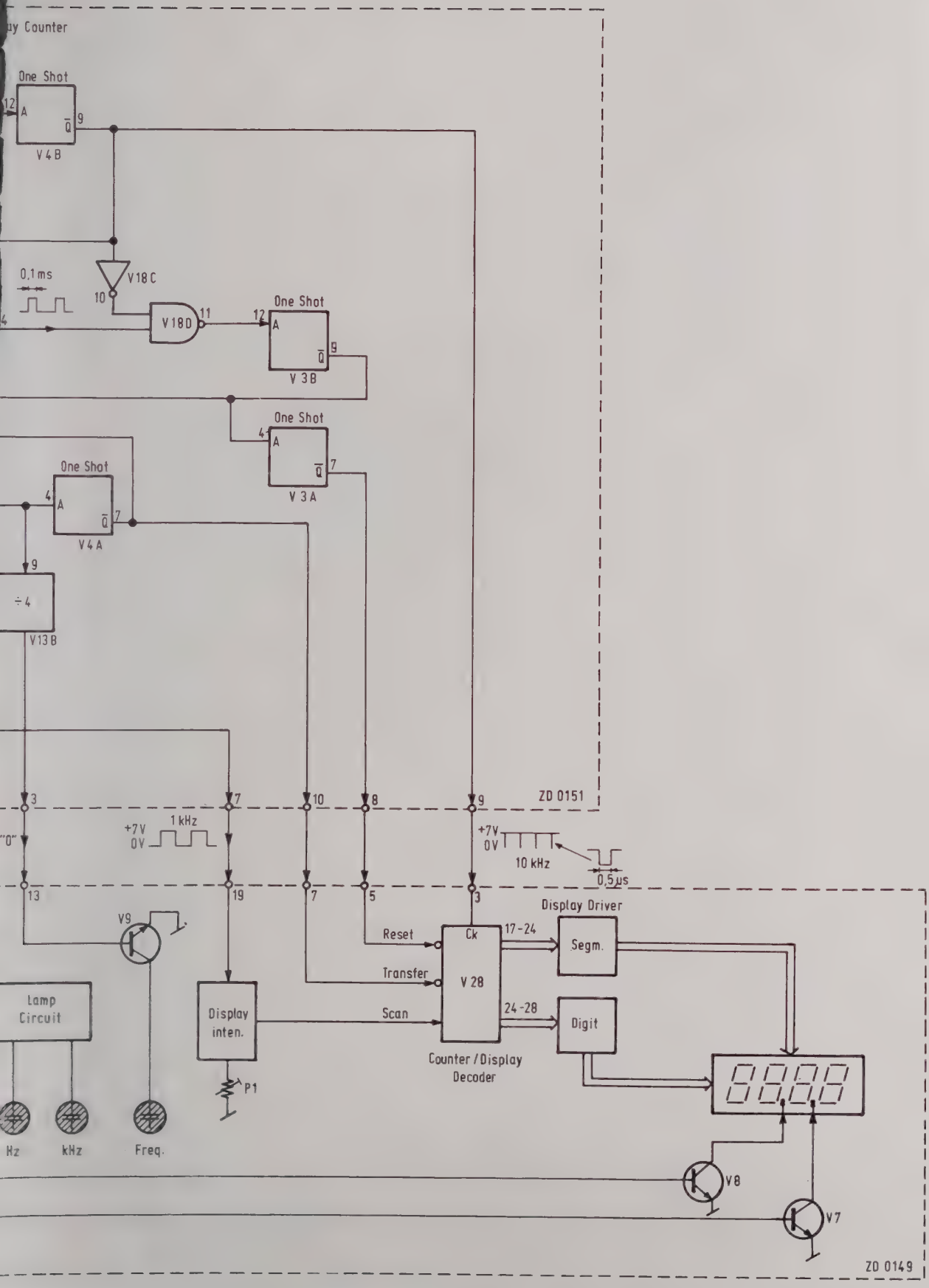
Change Input frequency to 220,0 Hz.
Check that the "Filter Center Frequency" Display shows 220 Hz ± 2 Hz.

The display intensity must be the same as the intensity of the lamps.
If necessary adjust P1 on ZD 0149.


To Display Counter
N-Divider
Dividers
Selector
V11
2MHz Osc.
C54
L1
ZD D150
V1, 2
V5D, 6D
+7V
0V
2MHz
200 k
V12A
÷10
V12B
÷10
V13A
÷10
V15, 16
From Decoder
Selector Position
Decade
2Hz – 20Hz → B
20Hz – 200Hz → A
200Hz – 2kHz → C
2kHz – 20kHz → D
ZD D151
TRACKING MODE
Filter Input
Tachm.
Manual
Noise
Numerator
Denominator
D-Divider
V3, 4, 5A, 6C
1kHz
MANUAL TUNING
TRACKING FREQ. MULTIPLIER
ZD D149
Manual Tuning Disc.
Tachometer Input
Ext. Tracking
Int. Tracking
Noise Filter
Track
Track/ Preset Select
Track "0"
Selector V12B, 14A, B, C
Track (Preset)
V9
Shift Preset → Track
Tuning Circuit 1623,3
Filter Input
1V RMS 1kHz
Tracking Filter 1623,4

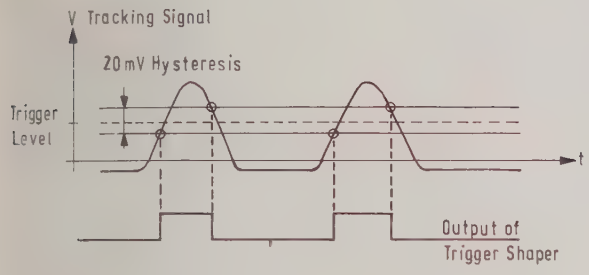

Periode Up Counter
Latch
V12
V16
V16
V3,4,5
Ck Enable
Preset=7
A
V6,7,8
Ck
B
19 - 30
V13C
V13D
V13B
+7V
0V
Decade Sh
40 µs
1 kHz
Decoder
10 µs
1 kHz
V14C
V15A,D
Q_D
Q_C
Q_B
V1
Ck Enable
Carry
V12F
Sequence Counter
Preset = 6
New Value
Old Value
One Shot
V2A
Latch
V16C,D
1 kHz
50 µs
0,5 µs
One Shot
V2B
V20
V17,18,19
Carry in
Counter Control
Digital Hysteresis
50 µs
1 kHz
+7V
0V
Z0 0150
Tuning wi
a De


Decade Shift Comparator
2MHz Clock
22-30
Ck
V 9,10,11
Carry
992
0111(1100xxx)
96
1100(xxx)
V 8
V 8
A
B
V 7
A
B
V 6
Down
Counter
Preset = Input
Value
V 19B
A>992
V19A
V 18 A
S
R
Catch
V19D
+7V
+7V
R8
P1
A>992
A<96
A<96
Q1
V19 C
Shift
Register
1kHz
Osc.
÷100
V1
Timing
V2
V17B
U/D
Ck
V 5
Q1-3
Reset
Decade Selector
Pin no.
16 15 14
Decade Q1 Q2 Q3
2 - 20 Hz 1 0 0
20 - 200 Hz 0 1 0
200 - 2 kHz 0 0 1
2 kHz - 20 kHz 0 0 0
Decoder
V14A, B
V15B
V17A,D,C
V20A,D,E
To Selector
14,15,16
15
5
4
14,15,16
V10
Latch
9
2,3,4
ZD 0150
Hz
kHz
10
Decade Shift
Filter
Output
1V RMS
Recorder
Sync.
Recorder
Sync.
Input Freq.:
> 2 kHz → "1"
< 20 Hz → "1"
17
15
Input Freq.:
(20-200)Hz → "1"
acking Filter 1623,4
Recorder Control 1623,5



Simplified Diagram 1623,2

Technical Description



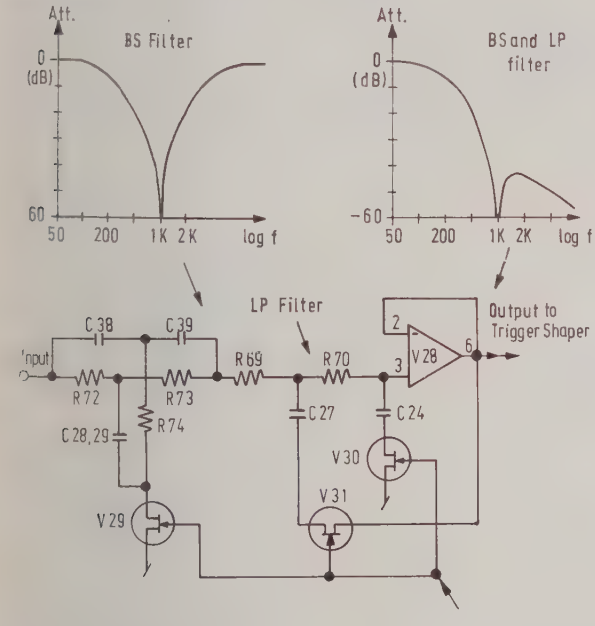
Practically any well defined periodic signal between 20 mVp and 120 Vp can be used to tune the Filter on "Tachometer Input". The tuning source for the filter is selected by the push buttons TRACKING MODE.

TACHM. INPUT: Selects the signal applied to "Tachometer Input".
FILTER INPUT: Selects the signal applied to "Filter Input".
MANUAL: The filter is tuned by the MANUAL TUNING knob.

TRACKING MODE	Track	Preset
"Filter Input" < 20 mVp	NO	YES
"Filter Input" > 20 mVp	YES	NO
"Tackm. Input" < 20 mVp	NO	YES
"Tackm. Input" > 20 mVp	YES	NO
"Manual"	YES	NO

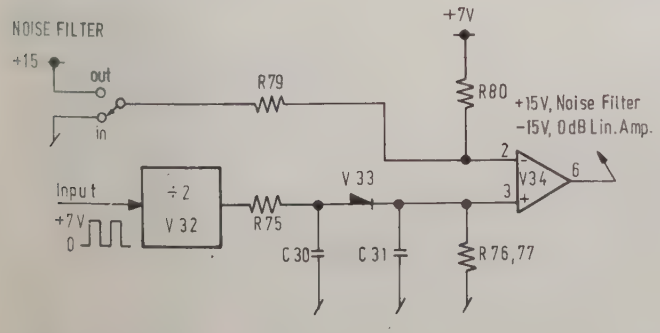
The tuning signal is fed via the Noise Filter to a Trigger Shaper. The frequency information is then fed to a Selector. The Selector is controlled by the Track/Preset Select Circuit to be in either "Preset" or "Track" pos. Output of the Selector is fed to Filter Logic and Display.

Noise Filter

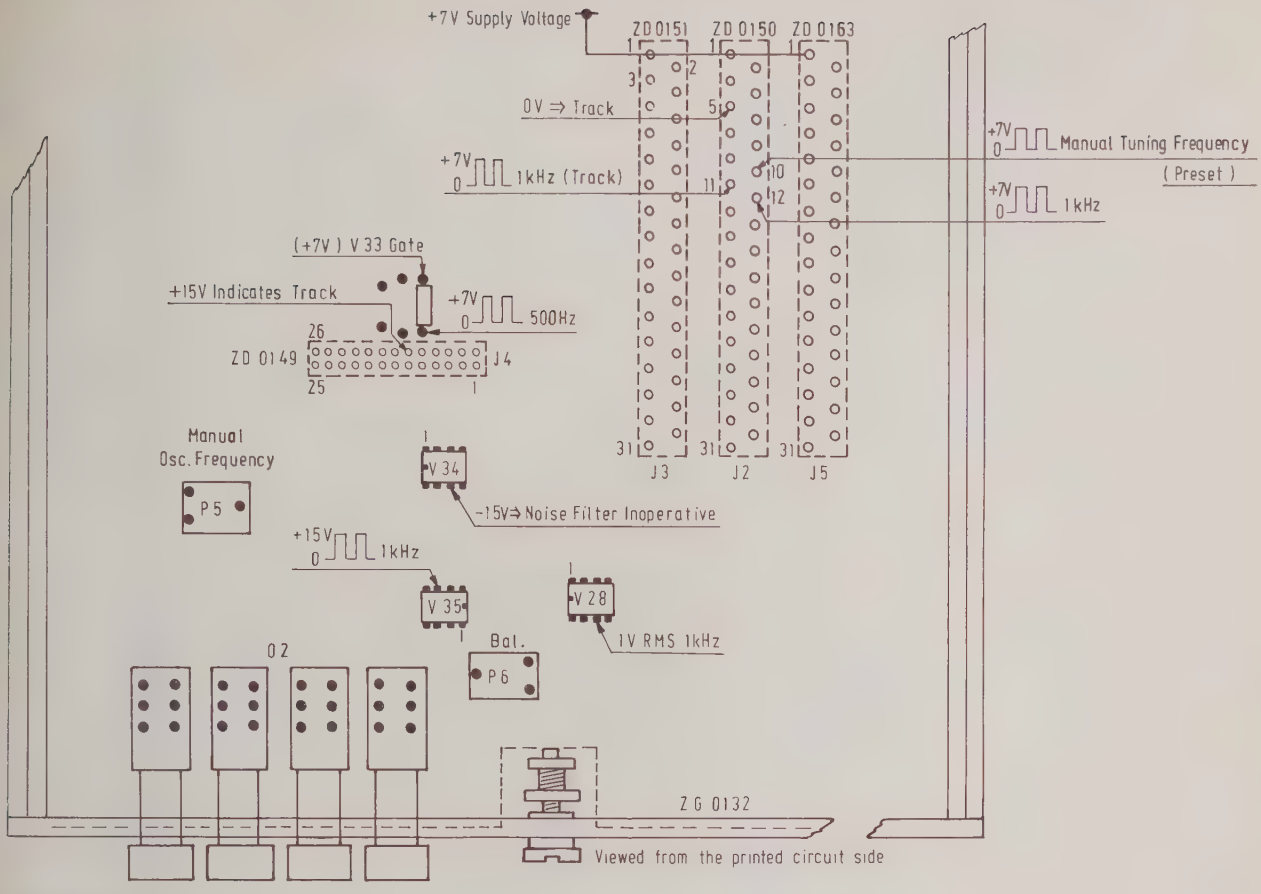


The Noise Filter consists of a BS Filter and a LP Filter. This is to ensure a max. rejection of higher frequency noise and especially the 1 kHz sync. tone on the B and K Test Records.

Noise Filter Switch Circuit



The Noise Filter Switch Circuit controls the Noise Filter conditions to either a 0 dB linear amplifier or a 200 Hz LP filter.
With NOISE FILTER pushed "In" the filter is active.
Furthermore the input frequency to V32 is integrated in R75 and C30 and gives a positive rectified voltage on V3 + input.
Which again, when the input frequency exceeds approx. 200 Hz, will switch the Noise Filter to be a 0 dB linear amplifier.
With "Manual" pushed in the Noise Filter is a 0 dB lin ampl. independent of NOISE FILTER button.



Adjustment

Manual Tuning

MANUAL TUNING/PRESET: "2 Hz—200 Hz"
TRACKING MODE: "Manual"
TRACKING FREQ. MULTI.: $\frac{N}{D}$ = "01"
MANUAL TUNING: "Fully counter clockwise"

Check that "Filter Center Frequency" shows 2,05 Hz ± 0,02 Hz.
If necessary adjust P5.

MANUAL TUNING/PRESET to "200 Hz—20 kHz"
MANUAL TUNING to "Fully clockwise"

Check that "Filter Center Frequency" shows > 20 kHz.
If necessary change value of R60.
The "Frequency" lamp should flicker.

Trigger Level

TRACKING MODE: "Tachm. Input"
TRACKING FREQ. MULTI.: $\frac{N}{D}$ = "01"
TRIGGER LEVEL: "+ 1 V"

Check the DC output of V28 (pin 6) to be within —1 V to —1,2 V.

TRIGGER LEVEL to "—1 V"

Check the DC output of V28 (pin 6) to be within + 1 V to + 1,2 V.

TRIGGER LEVEL to exactly "Mechanical middle Position"

Input signal to "Tachometer Input": 14 mV RMS 1 kHz.
Check with an oscilloscope the output of V35 (pin 6)
If necessary adjust P6.

Noise Filter Check

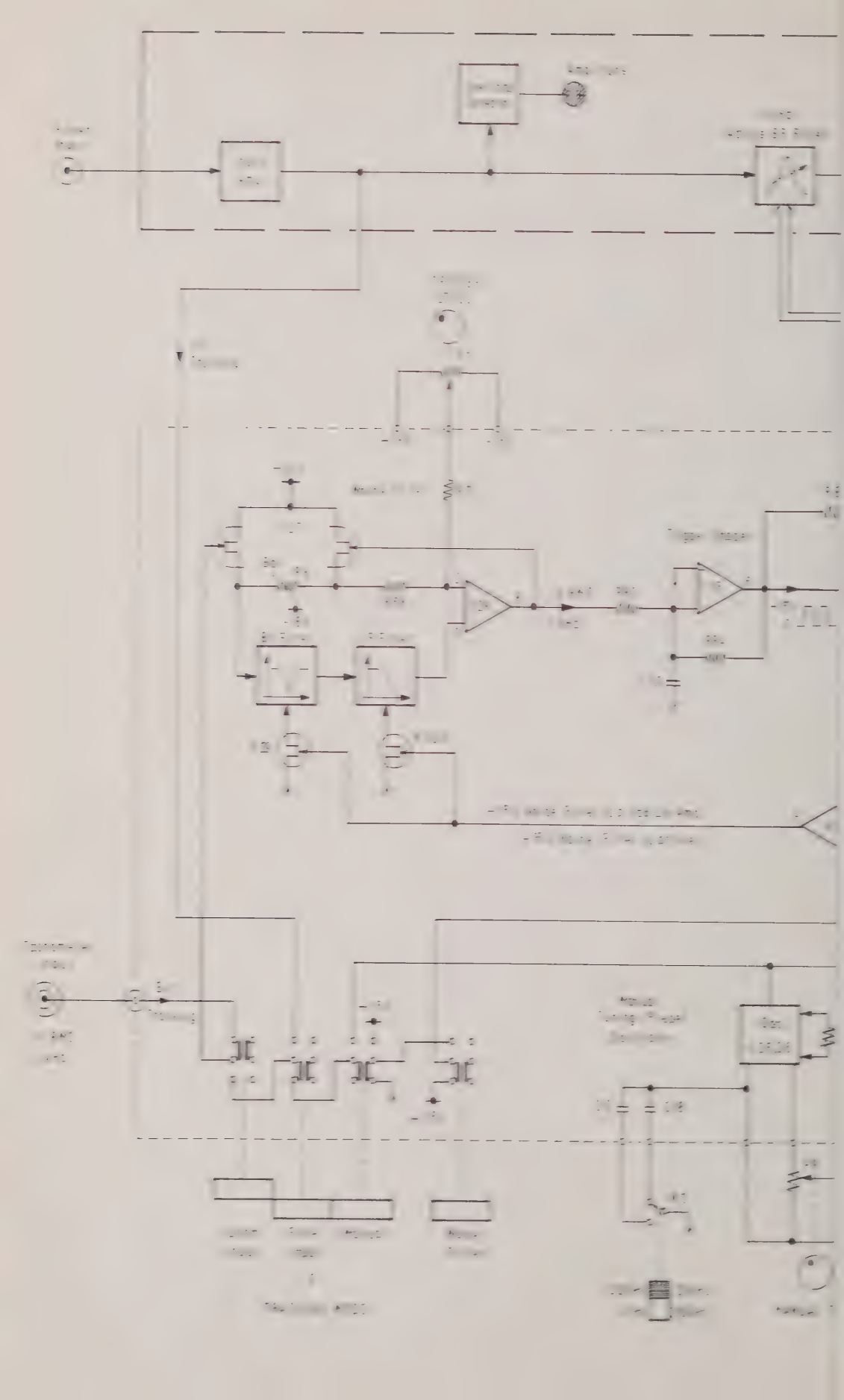
TRACKING MODE: "Tachm. Input"
TRIGGER LEVEL: "Middle Position"
TRACKING FREQ. MULTI.: $\frac{N}{D}$ = "01"

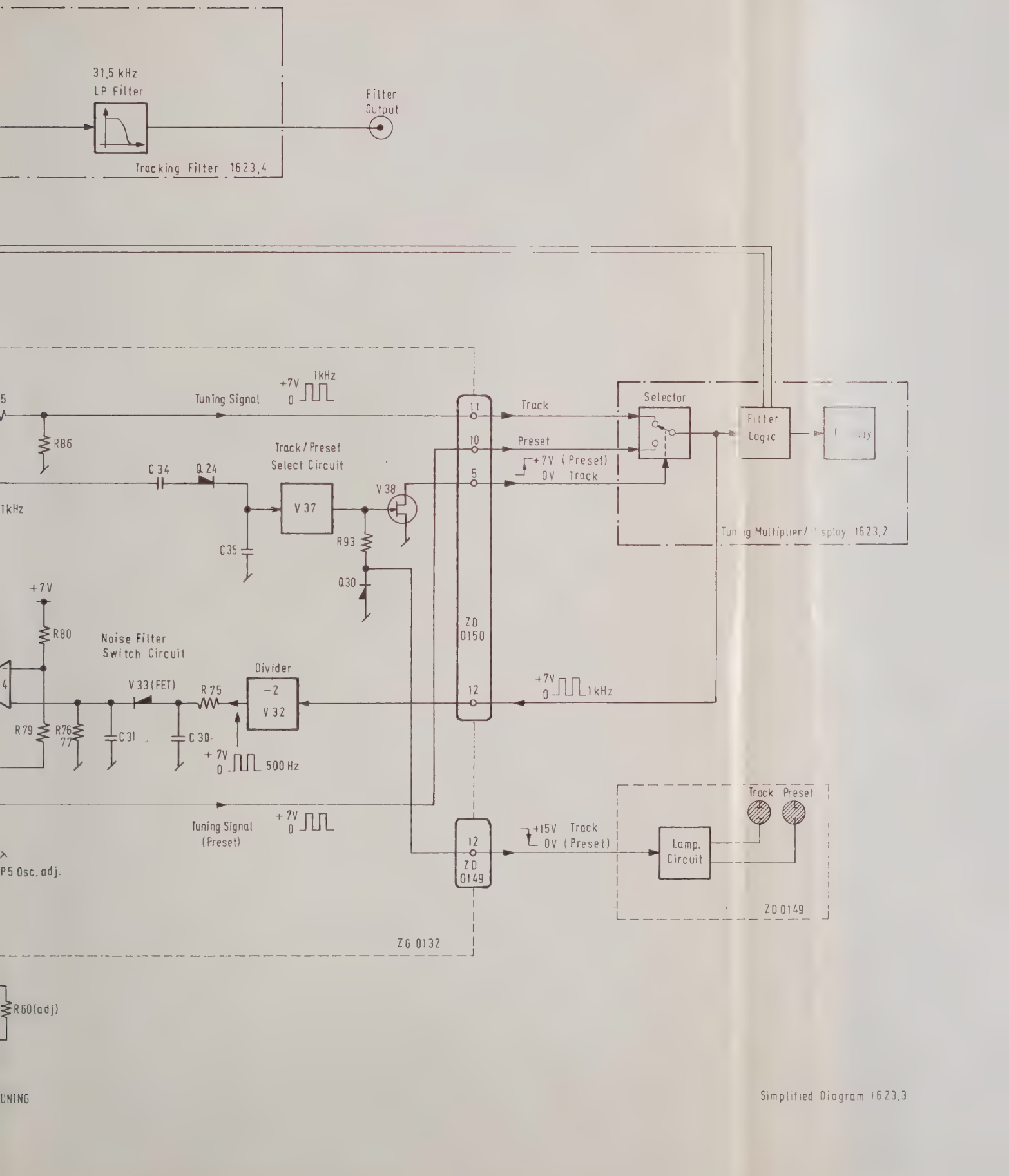
Input to "Tachometer Input": 1 V RMS 100 Hz.
To check the Noise filter it is necessary to inhibit the Noise Filter Switch Circuit.
This can be done by connecting the gate of V33 to + 7 V.
In this way the Noise Filter is working in the entire frequency range.

NOISE FILTER to "In"

"Track" lamp should be on. By increasing the input frequency slowly the shift from "Track" to "Preset" should take place before 1 kHz is reached.
If it is necessary to check the frequency response of the filter, this can be done by connecting a Level Recorder to V28 pin 6.

Remove the connection from + 7 V to gate of V33

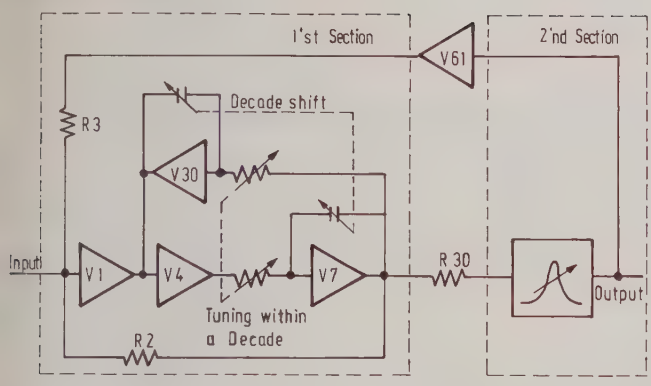




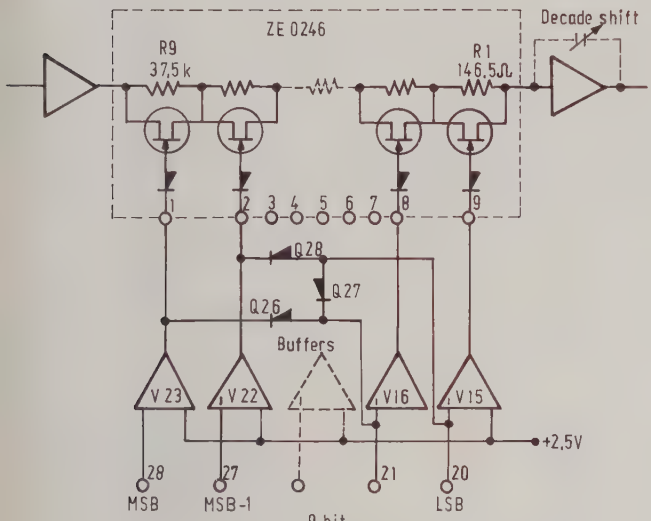
UNING

Simplified Diagram 1623,3

Technical Description



The filter is an active filter, tuned over a decade by a series of resistors which are switched in by a row of FET's. Both resistors and FET's are placed on four thick film circuits ZE 0246, mounted on ZT 0052. The filter consists of two sections each having two rows of tuning resistors r 1 — r 9. These resistors are digitally switched in from a 9 bit binary code. The resistor values follows the binary form, and "FET On" resistances are included.



One row of tuning resistors is shown. If faults appears in this circuit exchange ZE 0246.
The three diodes Q26, 27, 28 cuts off the two LSB when MSB is "1", and cuts off the LSB when MSB-1 is "1" seen from the buffer inputs. This makes always 7 bits in use instead of 9 bits, seen from the filter, and reduces the noise in the filter.

9 bit									Resolution	
(0	0)	0	1	1	0	0	0	0	2%	96
(0	0)	1	1	1	1	1	1	1	0,8%	255
(0)	1	0	0	0	0	0	0	(0)	1,6%	256
(0)	1	1	1	1	1	1	1	(0)	0,8%	511
1	0	0	0	0	0	0	(0	0)	1,6%	512
1	1	1	1	1	0	0	(0	0)	0,8%	992

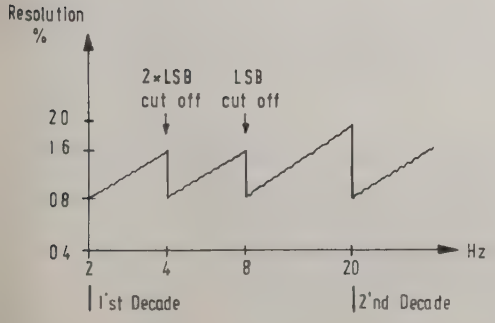
1 = - 15V, on output of buffers
0 = + 15V

At 96 the filter shifts to the next higher decade. The value is set by the Comparator. See 1623.2.

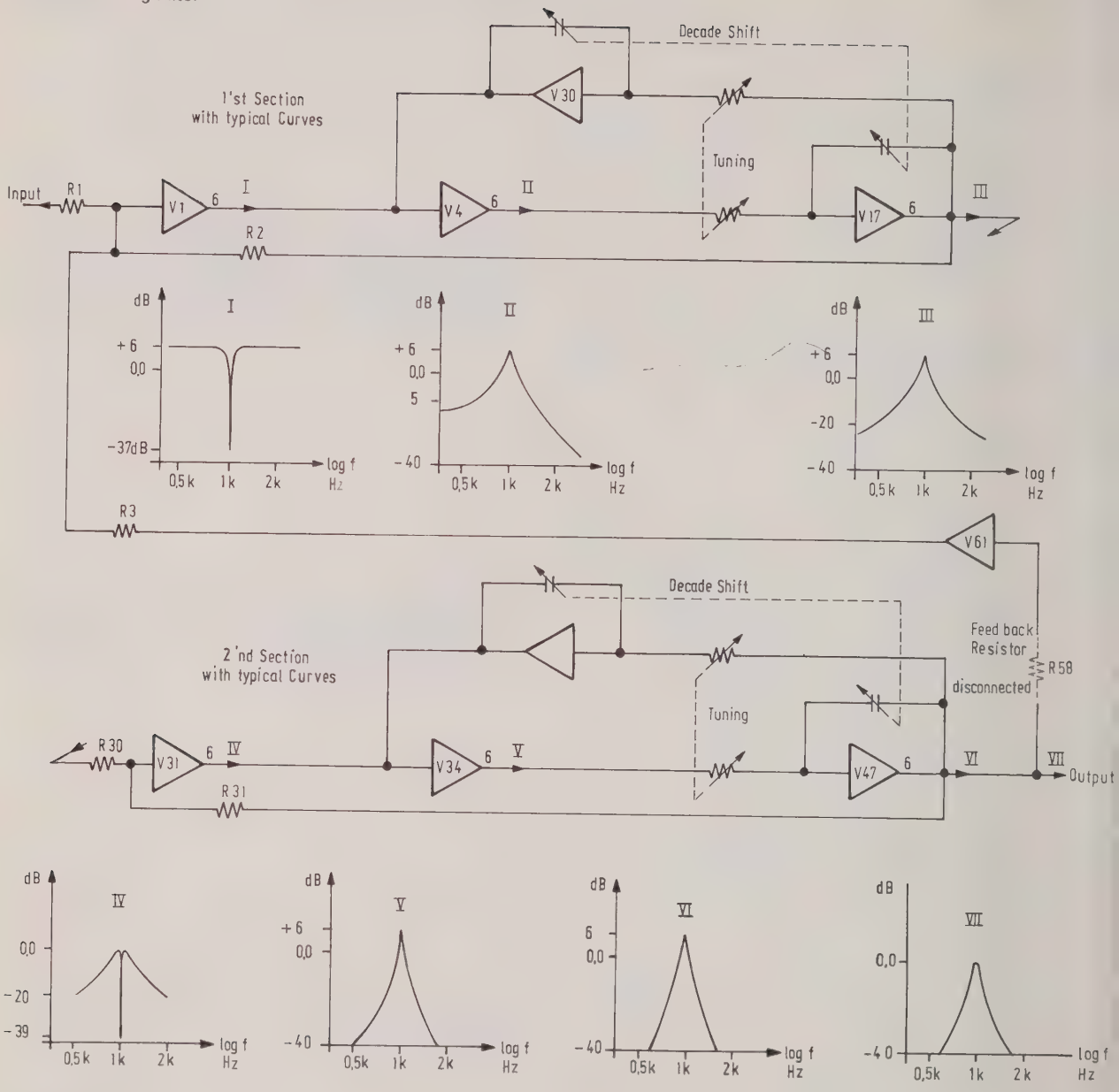
The LSB is cut off by Q28.

The two LSBs are cut off by Q26, 27.

At 992 the filter shifts to the next lower decade. The value is set by the Comparator. See 1623.2.



One decade consists of approx. 204 filter steps or filter center frequencies.



Trouble Shooting

TRACKING MODE: "Filter Input"
BANDWIDTH: "Lin"
TRACKING FREQ. MULTI.: $\frac{N}{D}$ = "$\frac{01}{01}$"

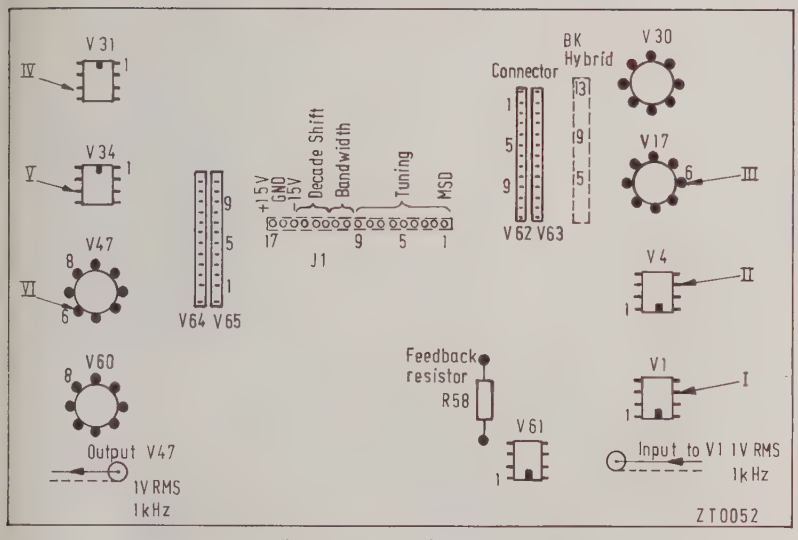
Disconnect the feedback resistor R58.
Check the DC offset voltage in the checkpoints I, II ... VI : 0 V ± 30 mV
Input signal to "Filter Input" 1 V RMS 1 kHz
Output voltage on "Filter Output" 1 V RMS .

TRACKING FREQ. MULTI. $\frac{N}{D}$ to "$\frac{00}{01}$"
BANDWIDTH to "12%"

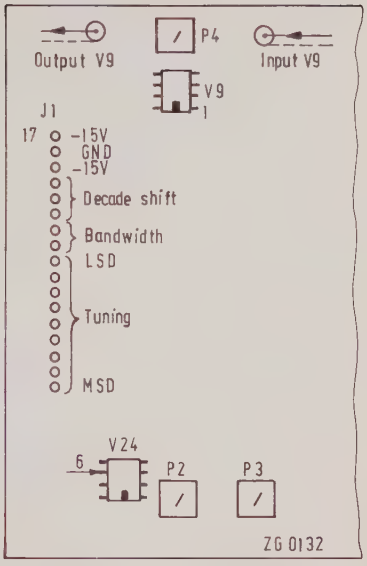
The positions of $\frac{N}{D} = \frac{00}{01}$ locks the Filter Center Frequency onto the latest input frequency 1 kHz, independent of the Clock Osc. drift and knob settings.
Sweep the extern generator and check the curves I, II ... VI. For curve I and IV it may be necessary to fine tune the input freq. to obtain the max. rejection.
All curves are typical.

Note, that the gain increases 6 dB in the 1'st Filter Section with R58 in open circuit.
Curve IV is attenuated by Curve III and will therefore not show the increase of 6 dB.

Curve VII is shown with the feedback resistor R58 replaced.



Viewed from the printed circuit side



Viewed from the component side

Adjustment

Off-Set

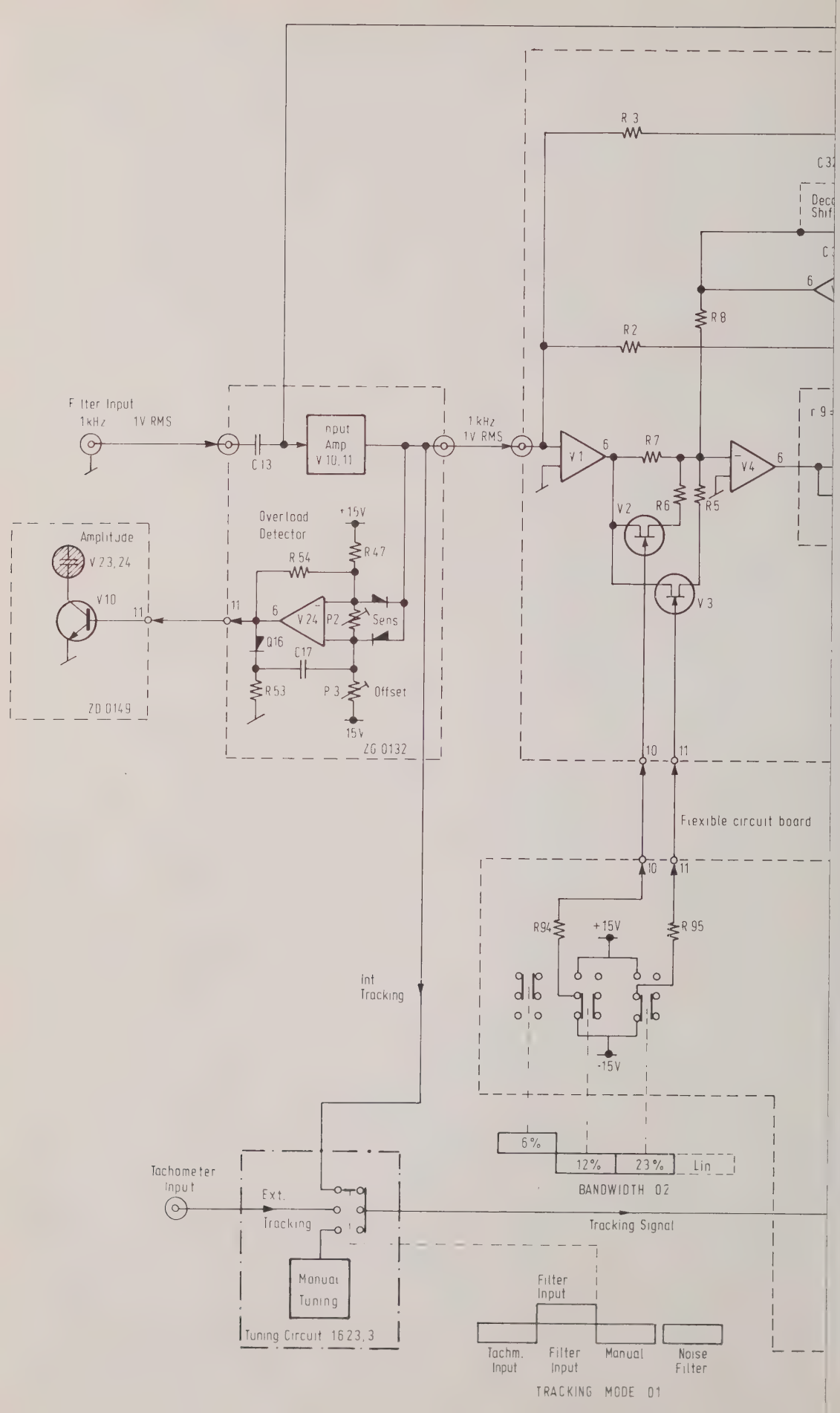
MANUAL TUNING/PRESET: "2 Hz — 200 Hz"
TRACKING MODE: "Manual"
BANDWIDTH: "23%"
TRACKING FREQ. MULTI.: $\frac{N}{D}$ = $\frac{"01"}{01}$
MANUAL TUNING: "Fully counter clockwise"

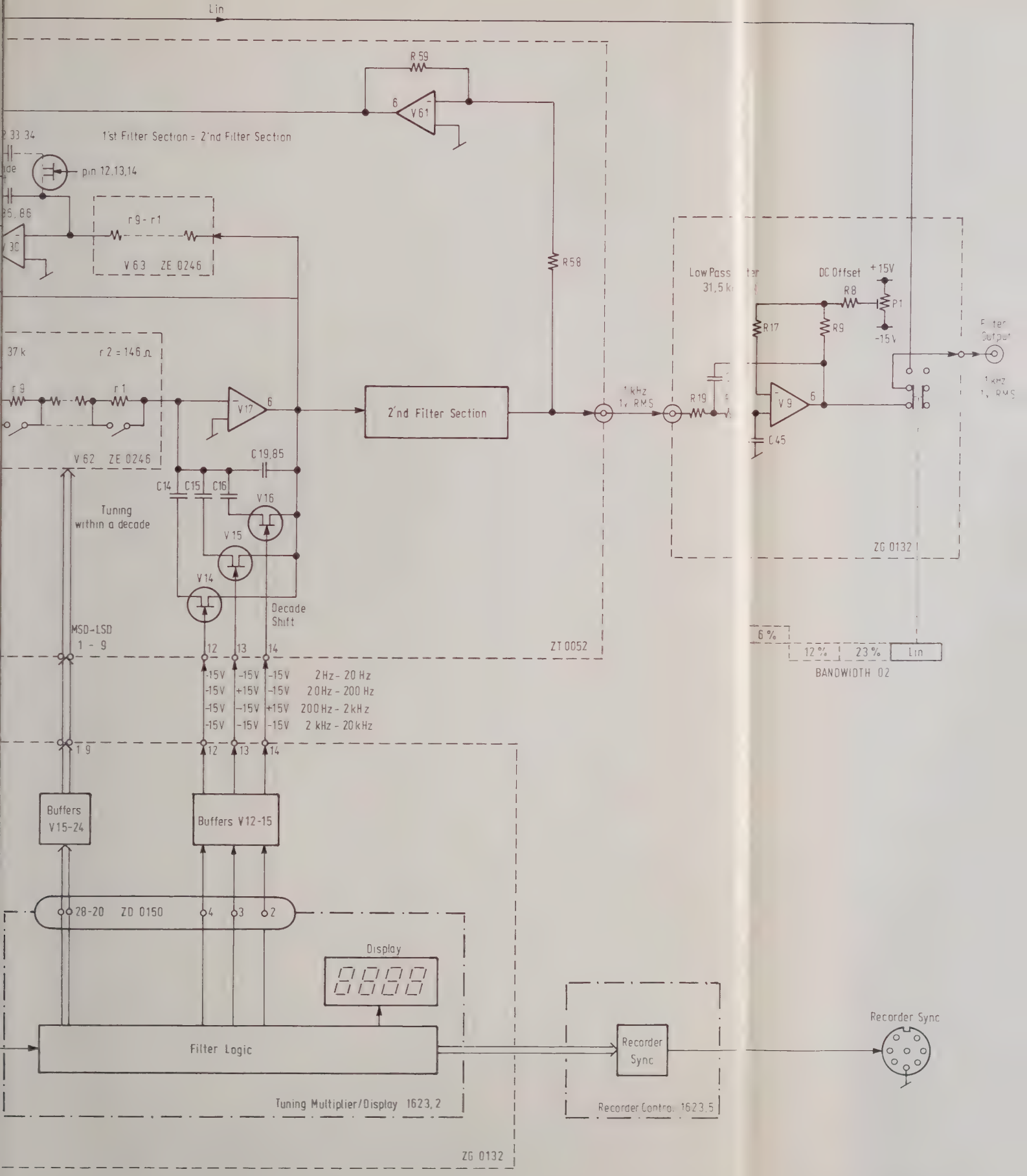
Short circuit "Filter Input".
Measure the DC off-set voltage on "Filter Output": 0 V ± 2 mV.
If necessary adjust P4 on ZG 0132.
If not possible check all the off-set voltages on the op-amp's pin 6 on ZT 0052 to be 0 V ± 30 mV.
Slowly turn MANUAL TUNING through the range. The off-set voltage on "Filter Output" should be 0 V ± 2 mV.

Overload (Amplitude)

TRACKING MODE: "Filter Input"
BANDWIDTH: "23%"
TRACKING FREQ. MULTI.: $\frac{N}{D}$ = $\frac{"01"}{01}$

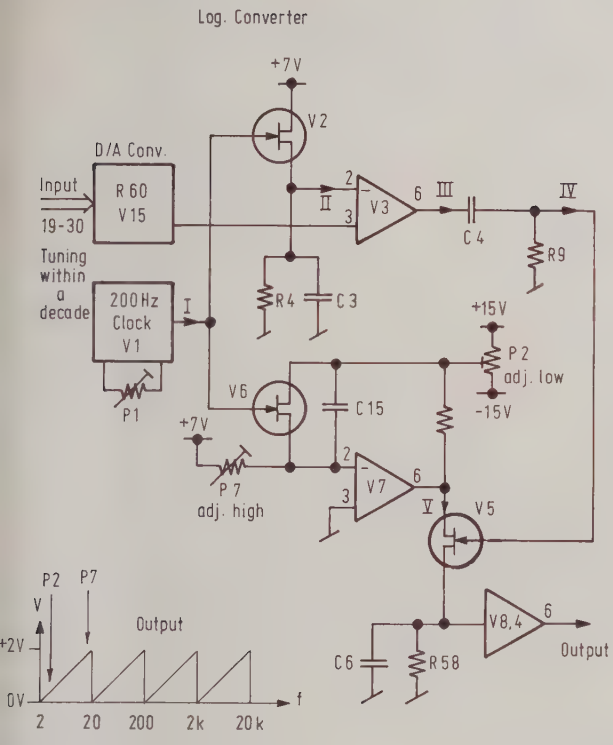
Measure the DC voltage on V24 pin 6 on ZG 0132 and adj. P3 for min. voltage: approx. —0,5 V.
Input signal to "Filter Input": 3 V RMS 1 kHz.
The "Amplitude" lamp should flicker.
By decreasing the input voltage to 2,8 V RMS the "Amplitude" lamp should stop flickering.
If necessary adjust P2 on ZG 0132.


R 3
R 8
R 2
R 7
R6
R5
V1
V2
V3
V4
6
10
11
F lter Input
1kHz 1V RMS
C13
nput Amp V 10, 11
1 kHz 1V RMS
Overload Detector
+15V
R 47
R 54
V 24
P2 Sens
Q16
C17
R 53
P 3 Offset
-15V
ZG 0132
Amplitude
V 23, 24
V 10
ZD 0149
Flexible circuit board
R94
R 95
Int Tracking
Tachometer Input
Ext. Tracking
Manual Tuning
Tuning Circuit 1623, 3
6%
12%
23%
Lin
BANDWIDTH 02
Tracking Signal
Filter Input
Tachm. Input
Filter Input
Manual
Noise Filter
TRACKING MODE 01



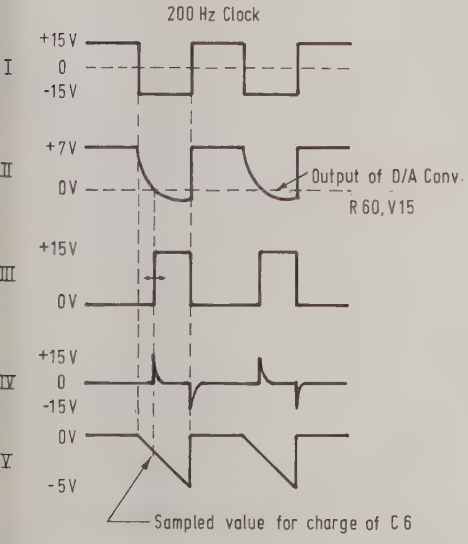
Simplified Diagram 1623.4

Technical Description

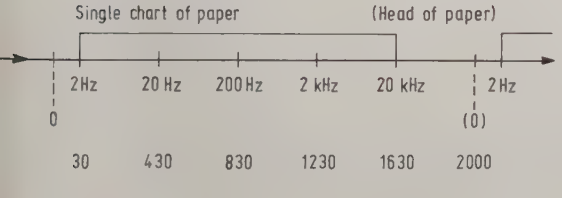


The 1623 Tracking Filter is provided with a Synchronization signal for the Level Recorder Type 2306. Also a DC Ramp voltage for controlling one of the axes of an X-Y recorder is provided.
For single chart length of paper (250 mm) the 1623 will deliver 2000 pulses. 400 pulses/decade. With a switch on the rear panel of the 1623 the paper movement may be selected to either "Forward Only" or "Forward and Reverse". The position "Forward and Reverse" can only be used together with the 2306, if this has a higher serial no. than 718058 or is modified with kit WB 0250.

Frequency information consisting of "Tuning within a Decade" is fed to the Recorder Sync. Board ZD 0163.
The tuning information (pin 19—30) is D/A converted (R60) and fed to the Log Converter. A Decade weighting is added to the log convertion on the input of V9. See the Simplified Diagram.

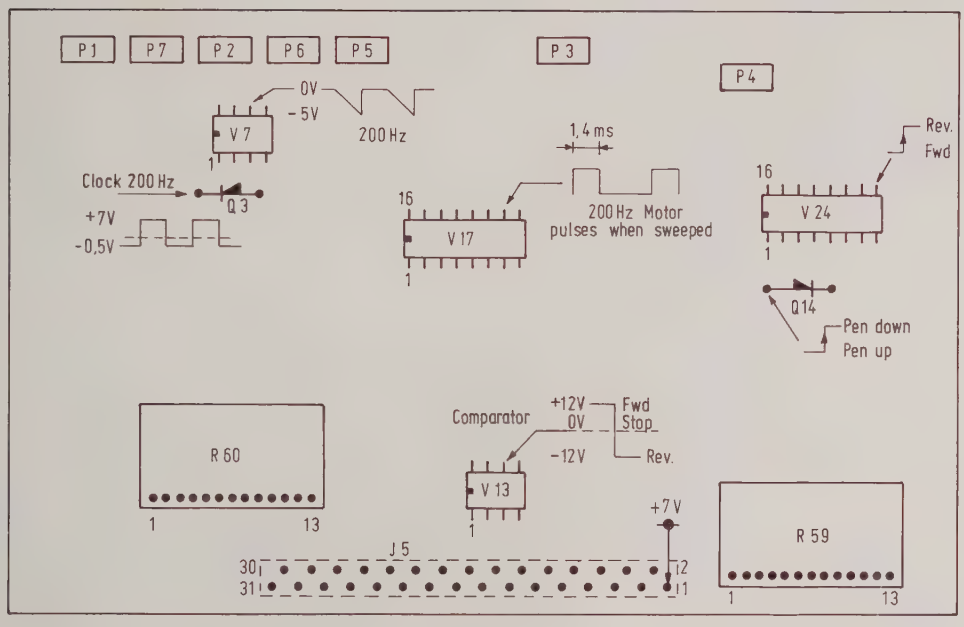


The Log function is taken from C3//R4. The max paper speed is set by the 200 Hz clock, which is adjusted to 200 Hz ± 10 Hz.



At 2000 pulses the Counter V_{18-20} is reset by V_{21}. 2000 pulses correspond to a single chart of paper. The 200 Hz clock giving the Motor Sync. pulses for the 2306, gives a paper speed of 25 mm/s if the paper is continuously running.

The number of pulses n to the Recorder Sync.
$n = 400 \log \frac{f1}{f0}$ between two frequencies.



Viewed from the component side ZD 0163

Adjustment

Connect a Counter to "Recorder Sync." pin 7, and connect 2306 via cable AQ 0182 to 1623 "Recorder Sync.".
If no 2306 is available it is necessary to place a pull up resistor of approx. 1 kΩ between pin 7 and + 7 V, to obtain correct counting of the sync. pulses for the Motor.

Measure the clock freq. with a Counter, 200 Hz ± 10 Hz on V1 pin 6.
If necessary adjust P1 on ZD 0163.

Knob settings:

BATTERY: "On"
TRACKING MODE: "Tachm. Input"
TRACKING FREQ.MULTI: N = $\frac{\text{"01"}}{01}$
RECORDER SYNC.: "Fwd Only" (on rear)

Input signal to "Tachometer Input" 1 V RMS 2 Hz exactly.
If the "Filter Center Frequency" shows less than 2 Hz it should be noted that the Recorder Sync. pulses are inhibited, and the "Frequency" lamp is flickering.

a RECORDER SYNC., press "Reset Fwd"

Reset the Counter

RECORDER SYNC., press "Start"

The Counter should show 30 ± 2 pulses.
If necessary adjust P2. And repeat item a.
If not possible to obtain 30 ± 2 pulses by adjustment of P2 then set P6 to middle position, and repeat item a.

b RECORDER SYNC., press "Reset Fwd"

Change input freq. to 18 Hz.
Reset the Counter

RECORDER SYNC., press "Start"

The Counter should show 412 ± 2 pulses.
If necessary adjust P7, and repeat item b.

c RECORDER SYNC., press "Reset Fwd"

Change input freq. to 180 Hz.
Reset the Counter

RECORDER SYNC., press "Start"

The Counter should show 812 ± 2 pulses.
If necessary adjust P5, and repeat item c.

d RECORDER SYNC., press "Reset Fwd"

Change input freq. to 1,80 kHz.
Reset the Counter

RECORDER SYNC., press "Start"

The Counter should show 1212 ± 2 pulses.
If necessary adjust P4, and repeat item d.

e RECORDER SYNC., press "Reset Fwd"

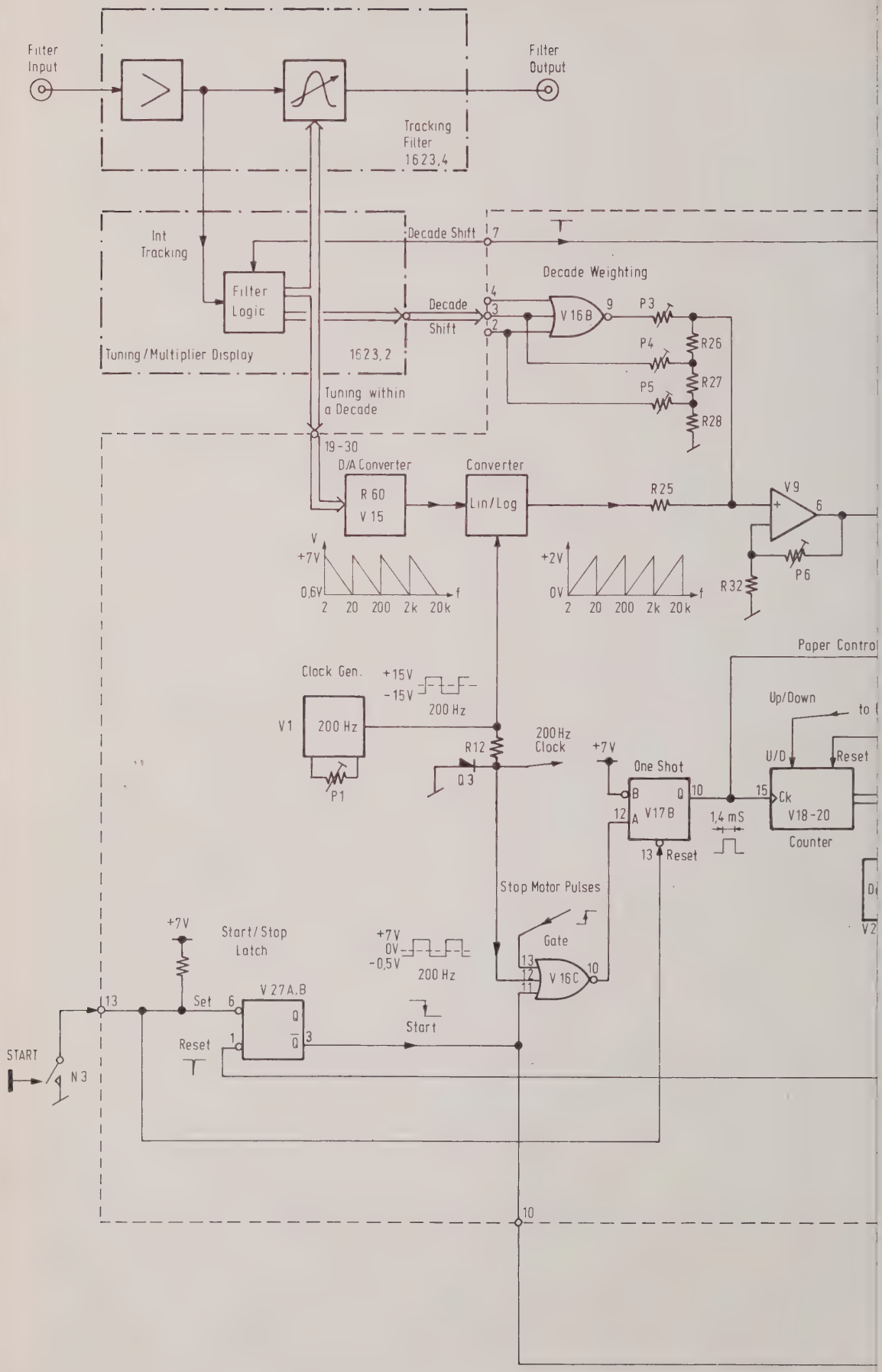
Change input freq. to 18,0 kHz.
Reset the Counter

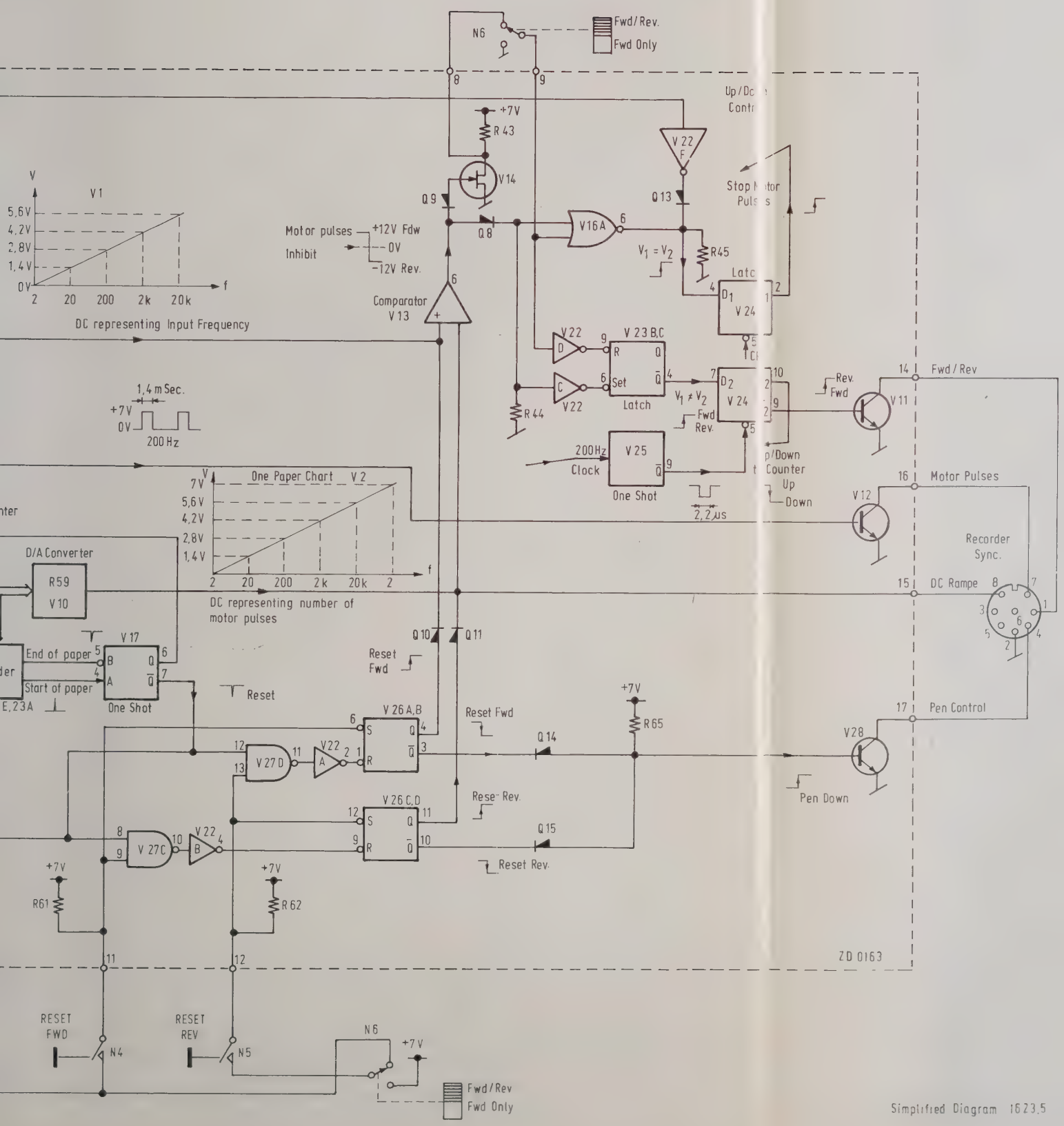
RECORDER SYNC., press "Start"

The Counter should show 1612 ± 2 pulses.
If necessary adjust P3, and repeat item e.

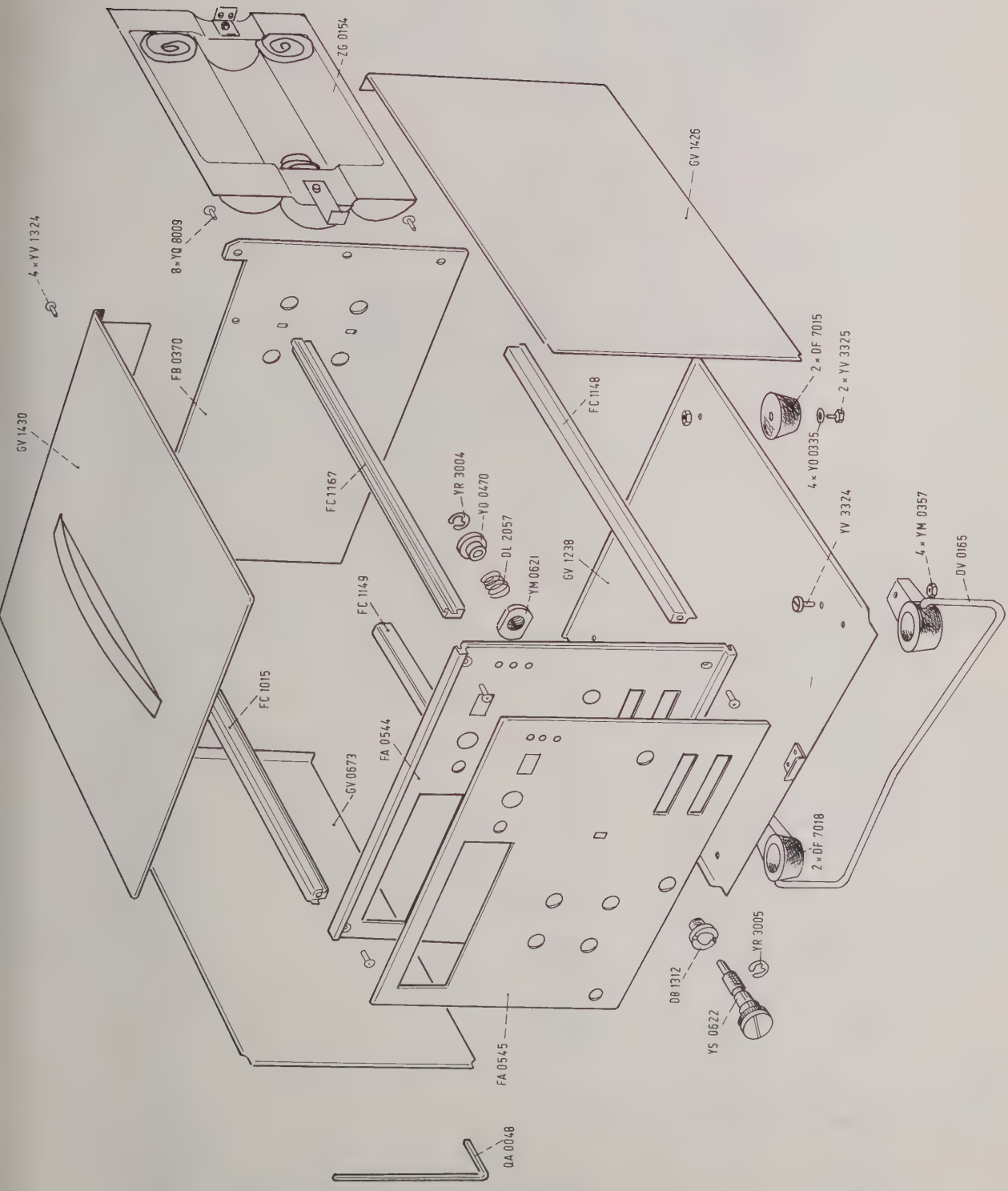
f RECORDER SYNC., press "Reset Fwd"

The Counter should now show 2000 ± 1 pulses.


Filter Input
Filter Output
Tracking Filter 1623,4
Int Tracking
Filter Logic
Tuning / Multiplier Display
1623,2
Decade Shift
Decade Shift
Decade Weighting
V 16 B
P3
P4
P5
R26
R27
R28
Tuning within a Decade
19-30
D/A Converter
R 60
V 15
Converter
Lin/Log
R25
V9
P6
R32
+7V
0,6V
2 20 200 2k 20k
+2V
0V
2 20 200 2k 20k
Paper Control
Clock Gen.
+15V
-15V
200 Hz
V1
200 Hz
P1
R12
Q3
200 Hz Clock
+7V
One Shot
V17B
1,4 mS
Up/Down
U/D
Reset
Ck
V18-20
Counter
Stop Motor Pulses
Gate
V 16 C
+7V
0V
-0,5V
200 Hz
Start/Stop Latch
V 27 A.B
Set
Reset
Start
START
N 3



Simplified Diagram 1623.5

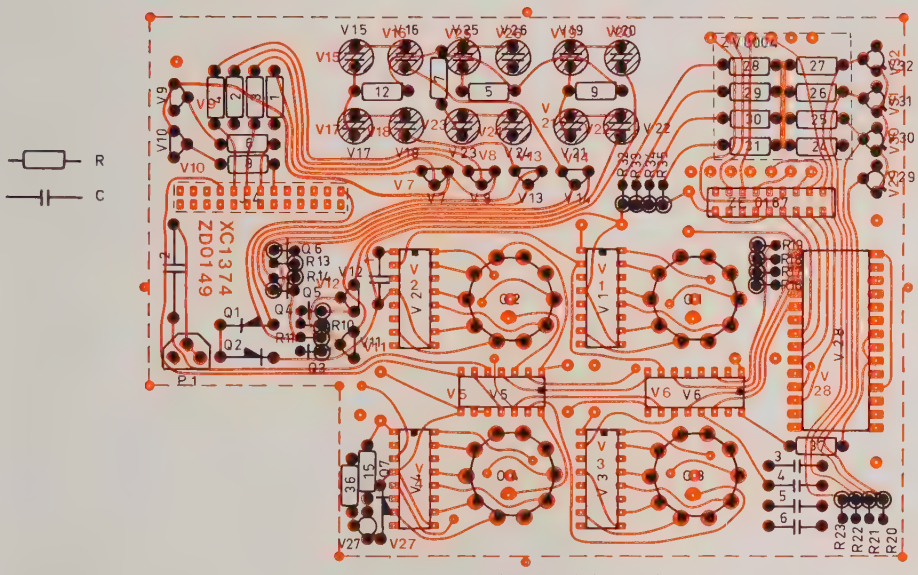

ZG 0154
GV 1426
4 × YV 1324
8 × YQ 8009
FB 0370
GV 1430
FC 1148
2 × DF 7015
2 × YV 3325
4 × YQ 0335
FC 1167
YR 3004
YQ 0470
DL 2057
YM 0621
GV 1238
YV 3324
4 × YM 0357
DV 0165
FC 1149
FC 1015
FA 0544
GV 0673
2 × DF 7018
DB 1312
YR 3005
YS 0622
FA 0545
QA 0048

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 40,41	Tantalum			2,2 µF/ 35 V	CF 0022
C 46	"			2,2 µF/ 35 V	CF 0022
C 47	"			1 nF/ 63 V	CT 1132
N 1,2	Selector				NN 0031
N 3-5	"Recorder Sync."				NT 0040
N 6	Selector				NN 0031
N 7	Switch, "Battery"				NN 0049
O 1	"Tracking Mode"				OZ 0015
P 7	"Trigger Level"			500 kΩ	PP 4505
P 8	"Manual Tuning"			1 MΩ	PP 5104
Q 29	Si.	1N4004		400 V/1 A	QV 0237
Q 33	Si.	1N4004		400 V/1 A	QV 0237
R 60	Metal	1/4 W	1%	5,49 kΩ	RF 3549
R 67	"	"	"	9,09 kΩ	RF 3909
R 87	Carbon	"	5%	1 MΩ	RB 6100
R 100	Wire	5 W	10%	12 Ω	RO 1208
	Set of screen cables				AO 1105
	Flat cable				AQ 0181
	Flexible circuit board				AR 1012
	Frame				DZ 9141
	Glass				SG 0053
	BNC Socket, "Filter Input"				JJ 0121
	BNC Socket, "Filter Output"				JJ 0130
	BNC Socket, "Tachomet Input"				JJ 0315
	7-pole DIN Socket				JJ 0709
	8-pole DIN Socket				JJ 0802
	Battery Indicator				IM 0011
	Locking Ring for above				YR 1011
	Battery				QB 0008
	Knob for "Tracking Freq. Multiplier"				SN 0076
	Scale for above				SD 0019
	Knob for "Trigger Level"				SN 2022
	Cover for above				DD 0089
	Knob for "Recorder Sync."				SN 0084
	Knob for "Manual Tuning"				SN 1025
	Fuse, slow	630 mA			VF 0032
	Fuse, slow	1,25 A			VF 0027
	Fuseholder				JS 0007
	Stand-off				XL 0063

Furthermore 1623 contains the following Sub-assemblies the details of which can be found under their respective numbers.

Digital Circuit	ZD 0149
Digital Circuit	ZD 0150
Digital Circuit	ZD 0151
Frequency Converter	ZD 0163
Mother Board	ZG 0132
Active Filter	ZT 0052

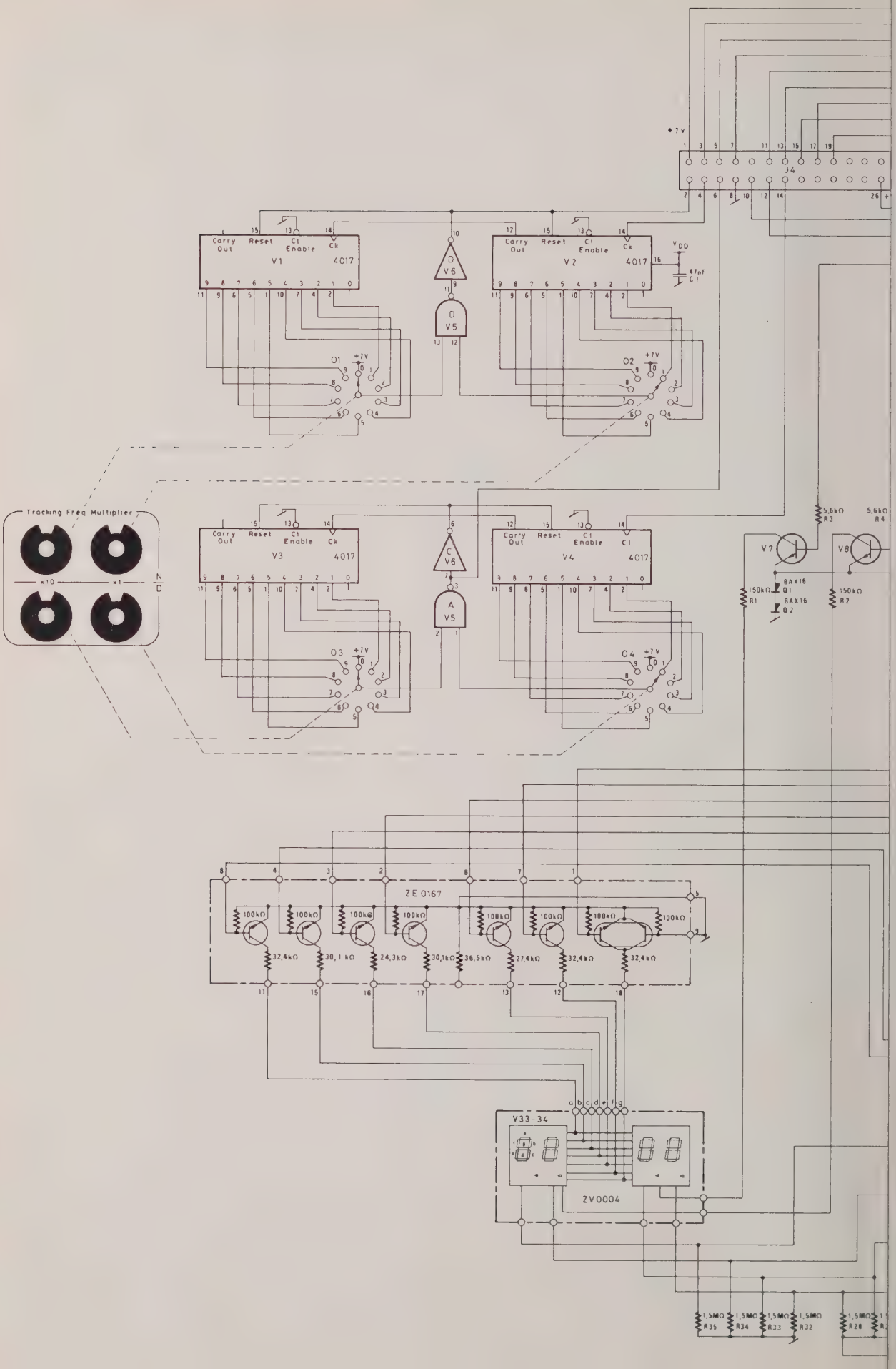
Circuit and Layout Diagram with Parts List

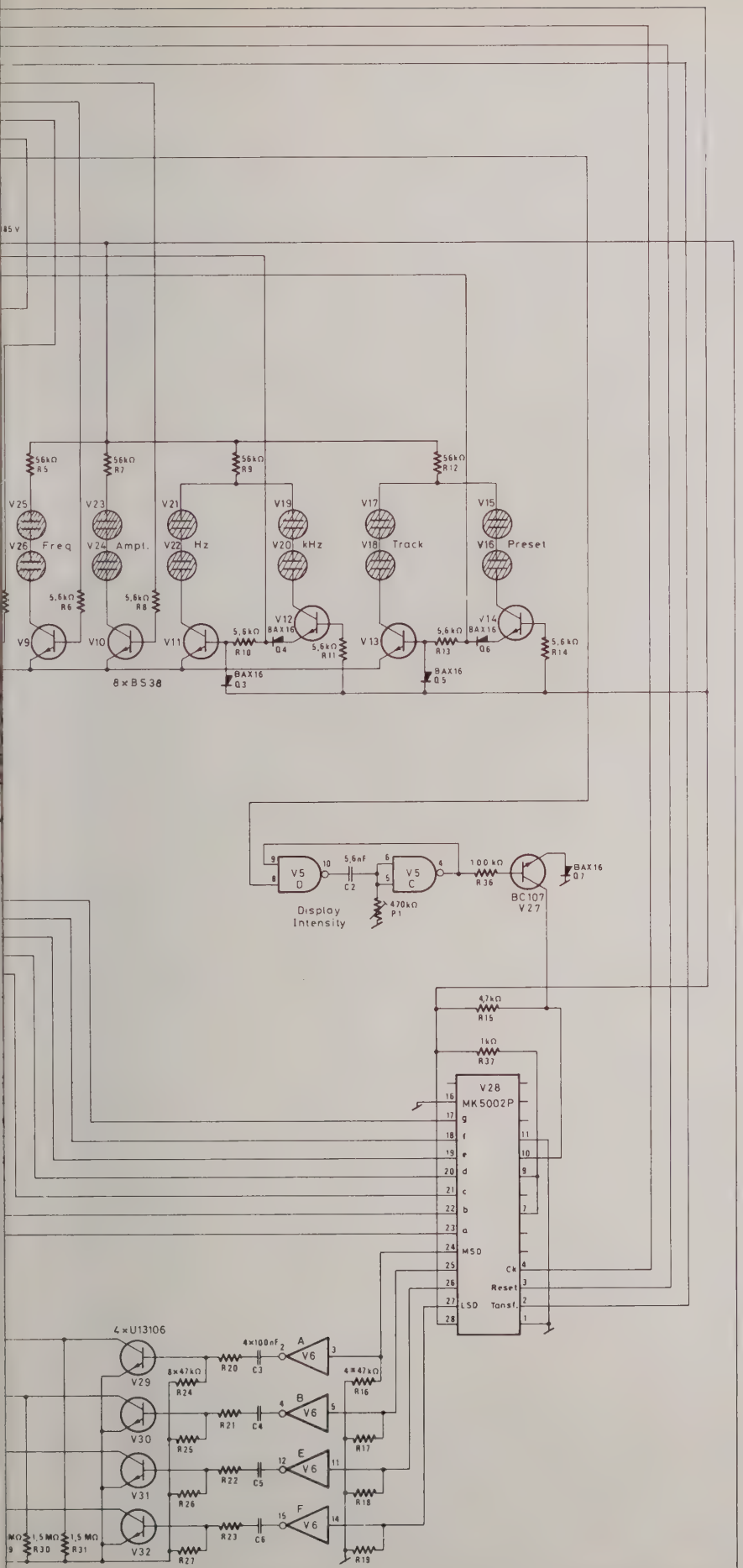


Viewed from the printed circuit side

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 1	Ceramic			47 nF/ 30 V	CK 4470
C 2	Polystyrene			5,6 nF/ 63 V	CT 1509
C 3-6	Polyester			100 nF/250 V	CS 0402
J 4	26-pin Plug for flat cable				JP 2603
O 1-4	Tracking Frequency Multiplier				OI 0022
P 1	Cermet	1/2 W	lin	470 kΩ	PG 4470
Q 1-7	Si.	BAX16		150 V/300 mA	QV 0217
R 1,2	Carbon	1/4 W	5%	150 kΩ	RB 5150
R 3,4	-	-	-	5,6 kΩ	RB 3560
R 5	-	-	-	56 kΩ	RB 4560
R 6	-	-	-	5,6 kΩ	RB 3560
R 7	-	-	-	56 kΩ	RB 4560
R 8	-	-	-	5,6 kΩ	RB 3560
R 9	-	-	-	56 kΩ	RB 4560

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 10,11	Carbon	1/4 W	5%	5,6 kΩ	RB 3560
R 12	-	-	-	56 kΩ	RB 4560
R 13,14	-	-	-	5,6 kΩ	RB 3560
R 15	-	-	-	4,7 kΩ	RB 3470
R 16-27	-	-	-	47 kΩ	RB 4470
R 28-35	-	-	-	1,5 MΩ	RB 6150
R 36	-	-	-	100 kΩ	RB 5100
R 37	-	-	-	1 kΩ	RB 3100
V 1-4	Decade Counter/ Divider			4017	VD 2063
V 5	Quad 2-input	NAND		4011	VD 2004
V 6	Hex Buffer Inv.			4049	VD 2024
V 7-14	Silicon	NPN		BSS38	VB 0549
V 15-26	Neon Lamp				VS 0015
V 27	Silicon	NPN		BC107	VB 0032
V 28	Counter/Display Decoder			MK5002P	VD 0065
V 29-32	Silicon	PNP		U13106	VB 0058
	Printed Circuit Board				XC 1374
	Thick Film Circuit				ZE 0167
	14-pin Socket				JJ 1408
	16-pin Socket				JJ 1622
	28-pin Socket				JJ 2800
	Reflector				DZ 9299
	Display Unit				
V 33,34	Sperry Display				VA 0097
	Socket for display				JV 0011
	PC Board without components				XC 1378
	PC Board with components				ZV 0004


+7 V
J4
Carry Out
Reset
Cl Enable
Ck
V1
4017
V2
4017
V3
4017
V4
4017
D V6
D V5
C V6
A V5
VDD
47nF C1
O1
O2
O3
O4
Tracking Freq Multiplier
x10
x1
N
D
5,6kΩ R3
5,6kΩ R4
V7
V8
150kΩ R1
150kΩ R2
BAX16 Q1
BAX16 Q2
ZE 0167
100kΩ
32,4kΩ
30,1 kΩ
24,3kΩ
30,1kΩ
36,5kΩ
27,4kΩ
32,4kΩ
V33-34
ZV0004
1,5MΩ R35
1,5MΩ R34
1,5MΩ R33
1,5MΩ R32
1,5MΩ R28



Pos no	Type	No of pins	GND	V_{DD}
V 1	4017	16	8	16
V 2	"	"	"	"
V 3	"	"	"	"
V 4	"	"	"	"
V 5	4011	14	7	14
V 6	4049	16	8	16
V 28	MK5002P	28	1	28

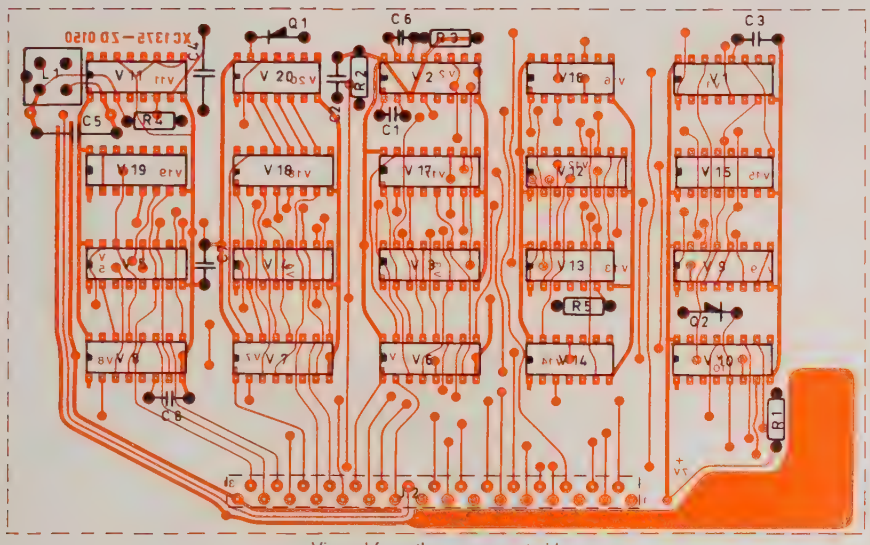
BC107
U13106

BS38

Circuit and Layout Diagram with Parts List

ZD 0150

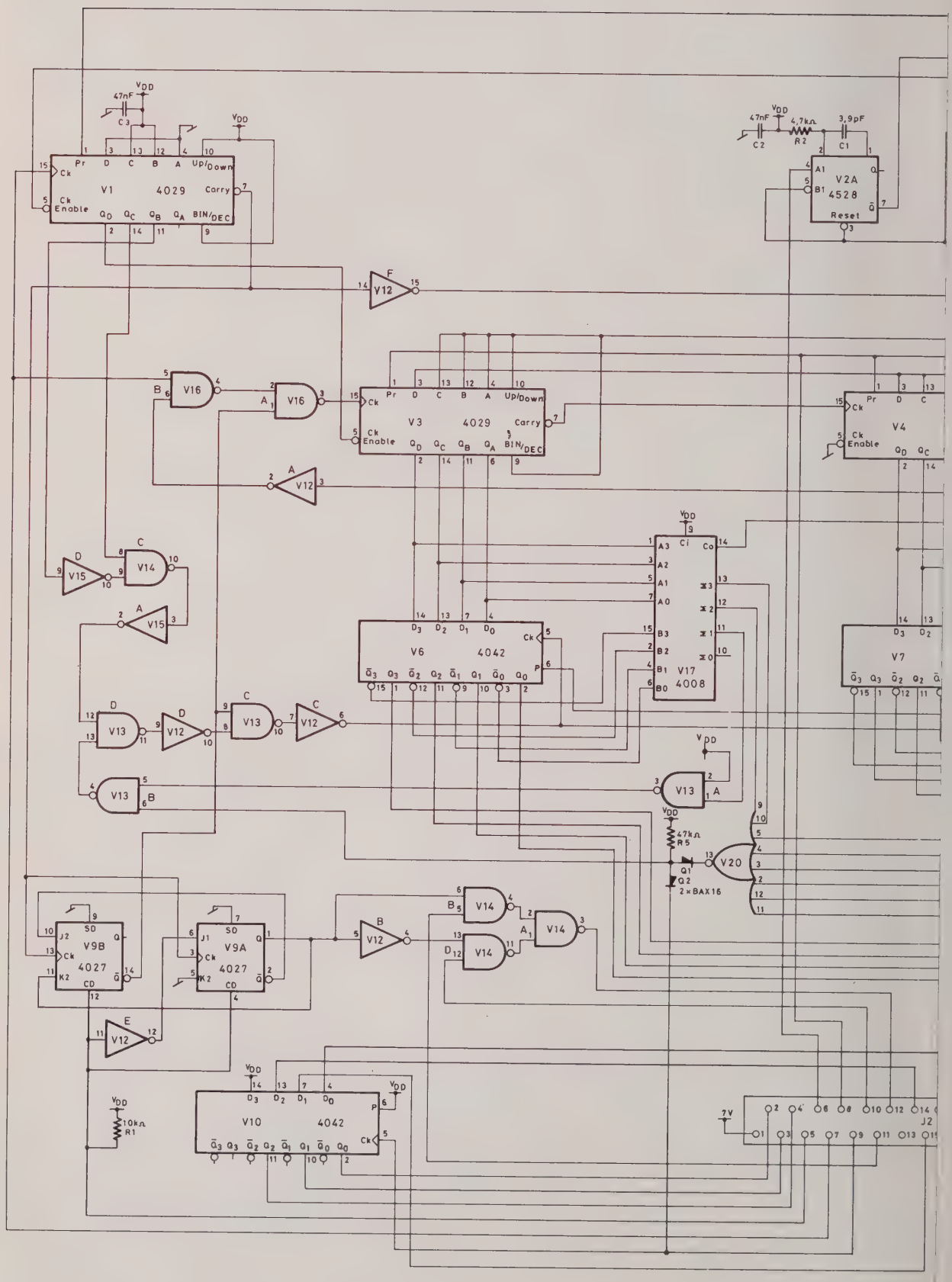
Digital Circuit

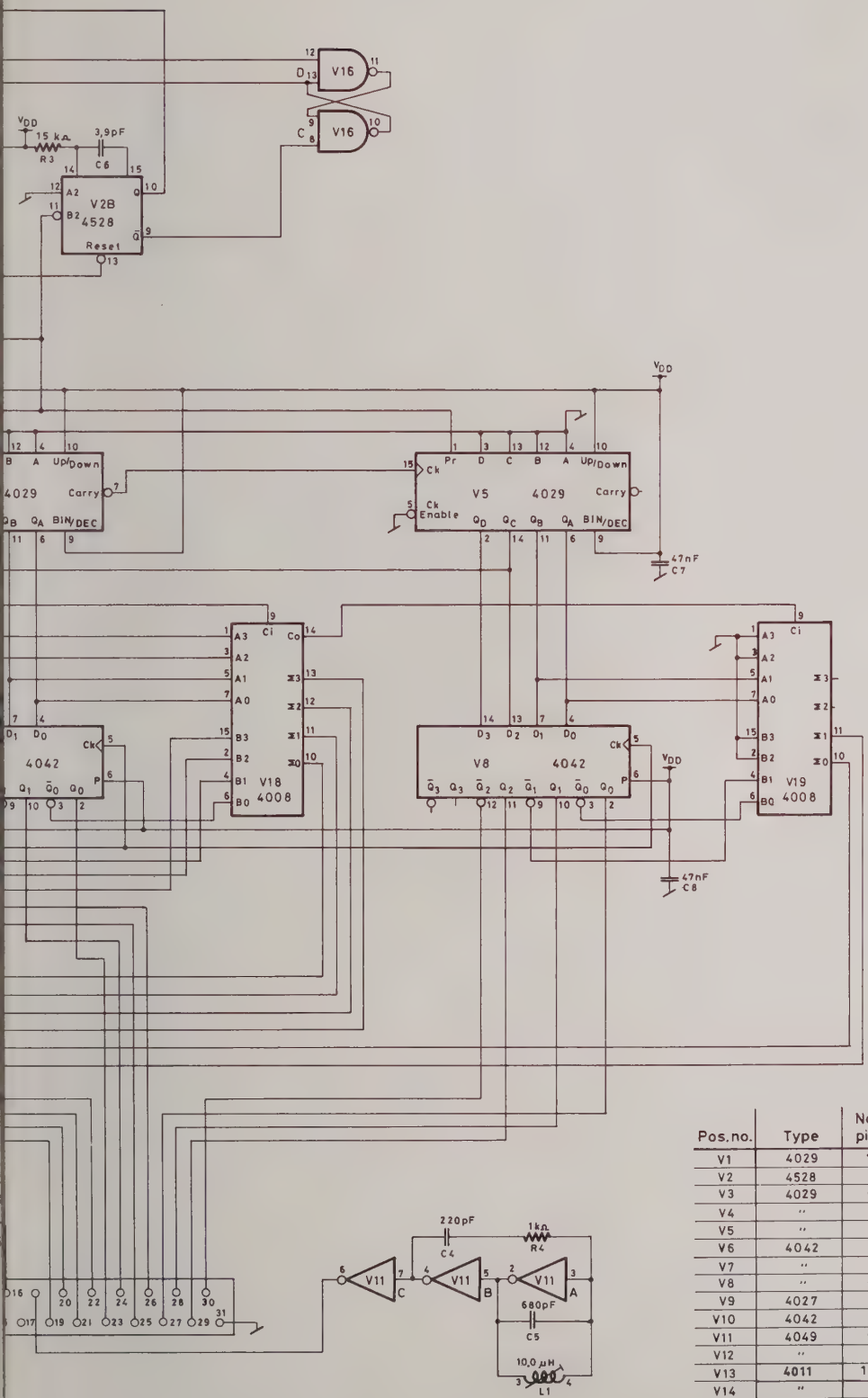


Viewed from the component side

CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
C 1	Ceramic		3,9 pF/250 V	CK 0390
C 2,3	-		47 nF/ 30 V	CK 4470
C 4	Polystyrene		220 pF/125 V	CT 0501
C 5	-		680 pF/125 V	CT 1134
C 6	Ceramic		3,9 pF/250 V	CK 0390
C 7,8	-		47 nF/ 30 V	CK 4470
J 2	31-pin Plug for circuit board			JP 3103
L 1	Coil		10 µH	LB 0903
Q 1,2	Si. BAX16		150 V/300 mA	QV 0217
R 1	Carbon	1/4 W 5%	10 kΩ	RB 4100
R 2	-	- -	4,7 kΩ	RB 3470
R 3	-	- -	15 kΩ	RB 4150
R 4	-	- -	1 kΩ	RB 3100
R 5	-	- -	47 kΩ	RB 4470

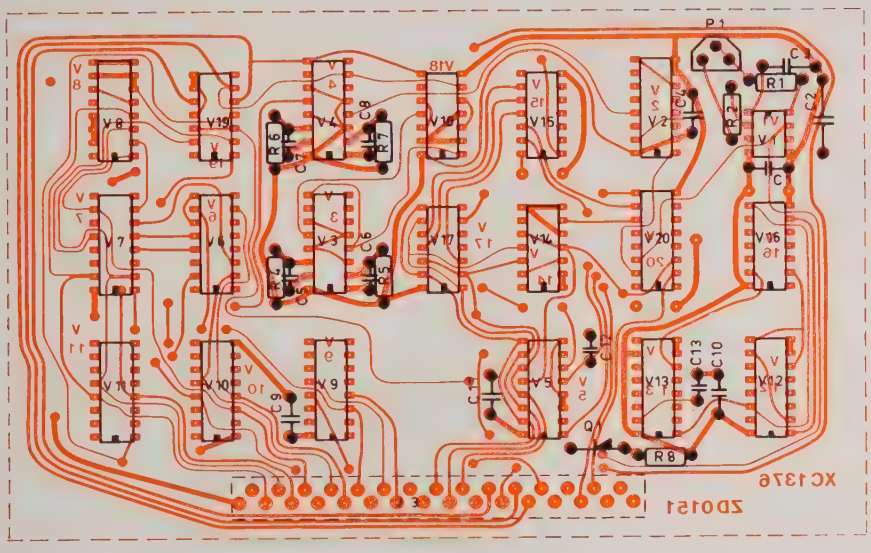
CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
V 1	Preset U/D Counter	4029	VD 2018
V 2	Dual Monostable Multivibr.	4528	VD 2032
V 3-5	Preset U/D Counter	4029	VD 2018
V 6-8	Quad Clocked "D" Latch	4042	VD 2023
V 9	Dual JK Flip-Flop	4027	VD 2016
V 10	Quad Clocked "D" Latch	4042	VD 2023
V 11,12	Hex Buffer INV	4049	VD 2024
V 13,14	Quad 2-input NAND	4011	VD 2004
V 15	Hex Buffer Inverter	4049	VD 2024
V 16	Quad 2-input NAND	4011	VD 2004
V 17-19	4-Bit Full Adder	4008	VD 2003
V 20	Single 8-input NOR	4078	VD 2040
	Printed Circuit Board		XC 1375
	14-pin Socket for dual-in-line		JJ 1408
	16-pin Socket for dual-in-line		JJ 1622


V1 4029
V2A 4528
V3 4029
V4
V6 4042
V7
V9A 4027
V9B 4027
V10 4042
V12
V13
V14
V15
V16
V17 4008
V20
47nF
C3
C2
C1
4,7kΩ
R2
3,9pF
47kΩ
R5
10kΩ
R1
2×BAX16
Reset
Up/Down
Carry
BIN/DEC
Enable
7V
J2



Pos.no.	Type	No.of pins	GND	V_{DD}
V1	4029	16	8	16
V2	4528	"	"	"
V3	4029	"	"	"
V4	"	"	"	"
V5	"	"	"	"
V6	4042	"	"	"
V7	"	"	"	"
V8	"	"	"	"
V9	4027	"	"	"
V10	4042	"	"	"
V11	4049	"	"	"
V12	"	"	"	"
V13	4011	14	7	14
V14	"	"	"	"
V15	4049	16	8	16
V16	4011	14	7	14
V17	4008	16	8	16
V18	"	"	"	"
V19	"	"	"	"
V20	4078	14	7	14

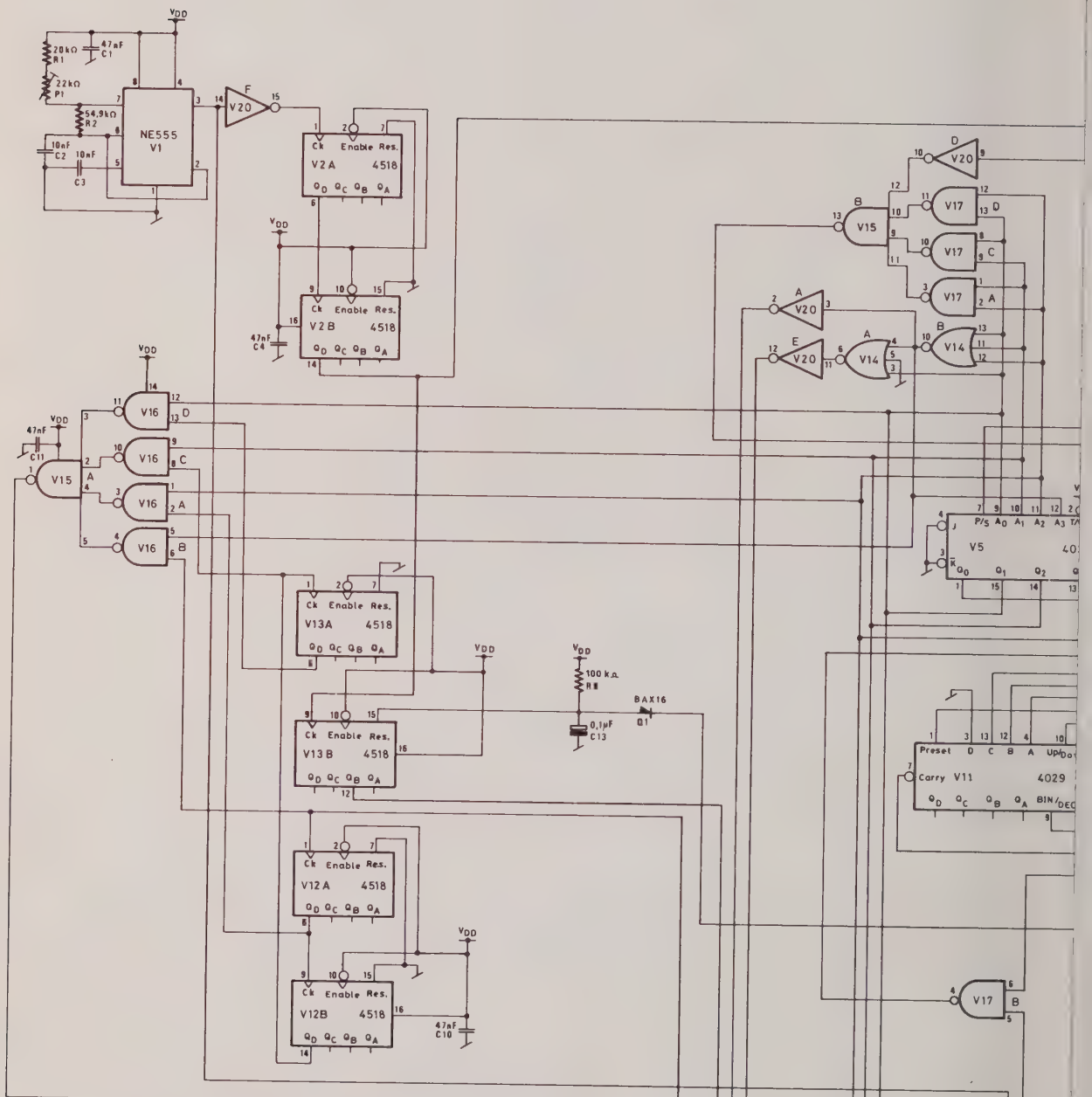
Circuit and Layout Diagram with Parts List



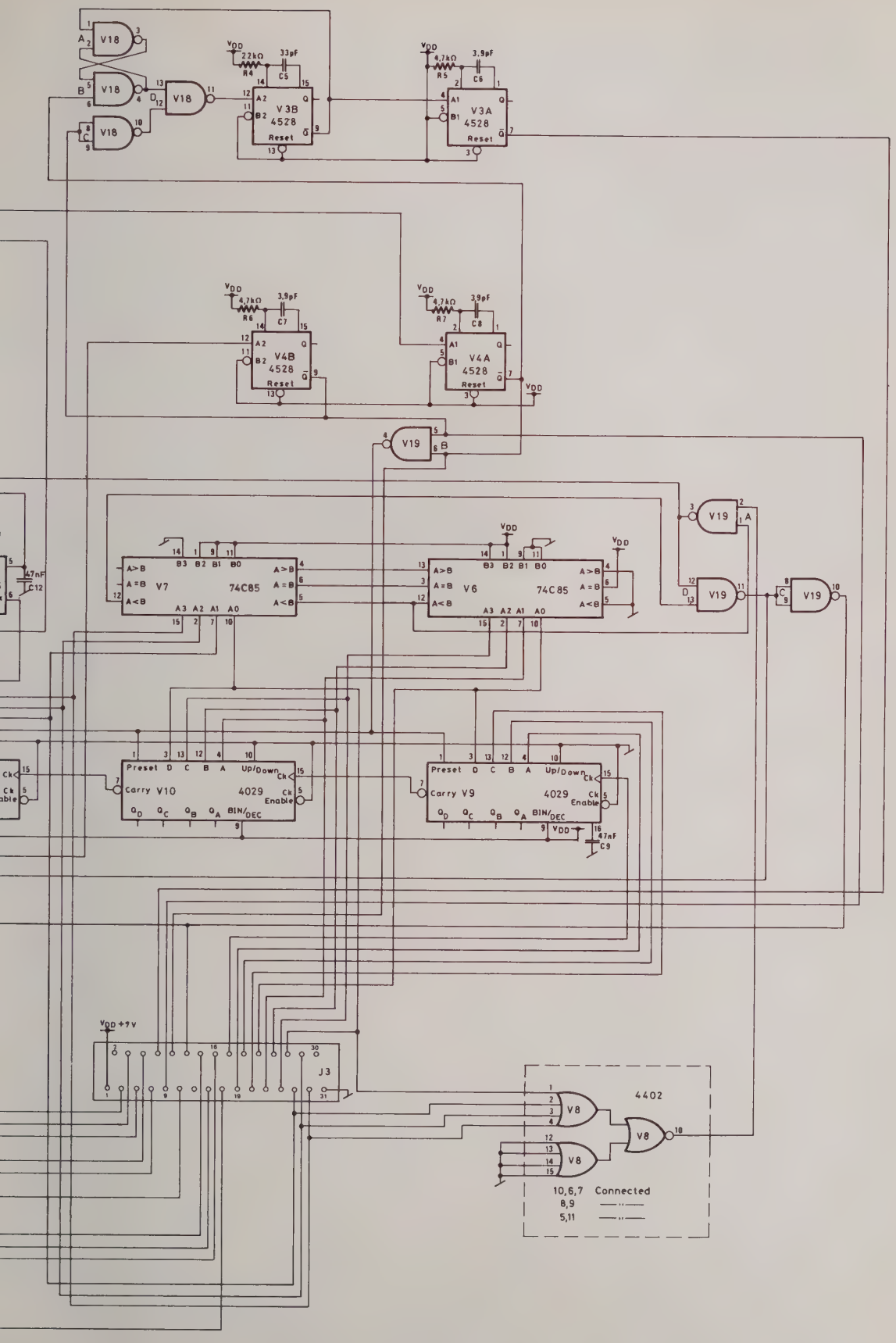
Viewed from the component side

CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
C 1	Ceramic	47 nF/ 30 V		CK 4470
C 2	Polystyrene	10 nF/ 63 V		CT 1545
C 3	Polyester	10 nF/250 V		CS 0403
C 4	Ceramic	47 nF/ 30 V		CK 4470
C 5	-	33 pF/400 V		CK 1330
C 6-8	-	3,9 pF/400 V		CK 0390
C 9-12	-	47 nF/ 30 V		CK 4470
C 13	Tantalum	0,1 µF/ 35 V		CF 0049
J 3	31-pin Plug for circuit board			JP 3103
P 1	Cermet	1/2 W	22 kΩ	PG 3220
Q 1	Si.	BAX16	150 V/300 mA	QV 0217
R 1	Metal	1/4 W	1% 20 kΩ	RF 4200
R 2	-	-	- 54,9 kΩ	RF 4549
R 4	Carbon	-	5% 22 kΩ	RB 4220
R 5-7	-	-	- 4,7 kΩ	RB 3470
R 8	-	-	- 100 kΩ	RB 5100

CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
V 1	Timer	NE555	VD 0062
V 2	Dual BCD Up Counter	4518	VD 2036
V 3,4	Dual Monostable Multivibr.	4528	VD 2032
V 5	4-Bit Parallel In/Out	4035	VD 2030
V 6,7	4-Bit Comparator	74C85	VD 2034
V 8	2 × 4 Exp. OR	4402	VD 2031
V 9-11	Preset U/D Counter	4029	VD 2018
V 12,13	Dual BCD Up Counter	4518	VD 2036
V 14	Tripple 3-input NOR	4025	VD 2015
V 15	Dual 4-input NAND	4012	VD 2005
V 16-19	Quad 2 input NAND	4011	VD 2004
V 20	Hex Buffer INV	4049	VD 2024
	Printed Circuit Board		XC 1376
	8-pin Socket for dual-in-line		JJ 0804
	14-pin Socket for dual-in-line		JJ 1408
	16-pin Socket for dual-in-line		JJ 1622



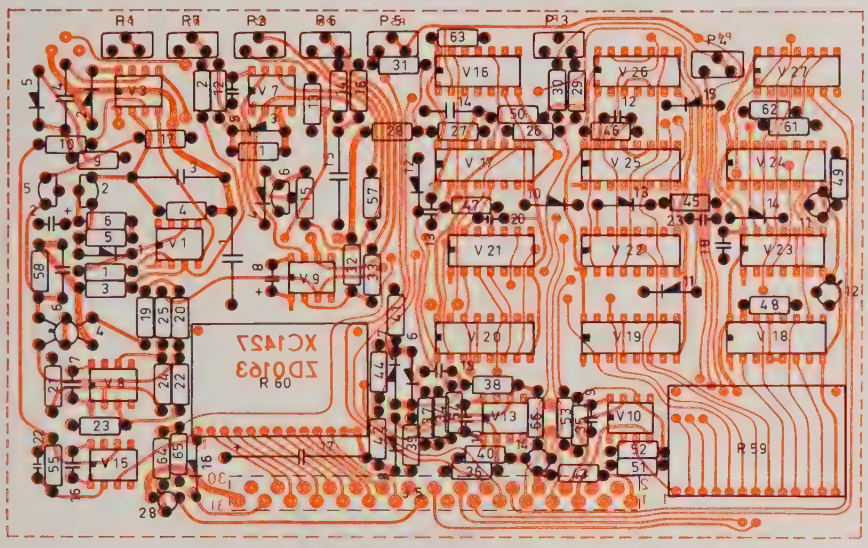
Pos.no.	Type	No.of pins	GND	V_{DD}
V 1	NE555	8	1	8
V 2	4518	16	8	16
V 3	4528	"	"	"
V 4	"	"	"	"
V 5	4035	"	"	"
V 6	74C85	"	"	"
V 7	"	"	"	"
V 8	4402	"	"	"
V 9	4029	"	"	"
V 10	"	"	"	"
V 11	"	"	"	"
V 12	4518	"	"	"
V 13	"	"	"	"
V 14	4025	14	7	14
V 15	4012	"	"	"
V 16	4011	"	"	"
V 17	"	"	"	"
V 18	"	"	"	"
V 19	"	"	"	"
V 20	4049	16	8	16


V18
V18
V18
V18
2.2kΩ
R4
33pF
C5
V3B
4528
Reset
4.7kΩ
R5
3.9pF
C6
V3A
4528
Reset
4.7kΩ
R6
3.9pF
C7
V4B
4528
Reset
4.7kΩ
R7
3.9pF
C8
V4A
4528
Reset
V19
V19
V19
V19
V7
74C85
V6
74C85
Preset
Carry V10
4029
Up/Down
Ck Enable
BIN/DEC
Preset
Carry V9
4029
Up/Down
Ck Enable
BIN/DEC
47nF
C9
47nF
C12
VDD +7V
J3
4402
V8
V8
V8
10,6,7 Connected
8,9 —"—
5,11 —"—

Circuit and Layout Diagram with Parts List

ZD 0163

Frequency Converter

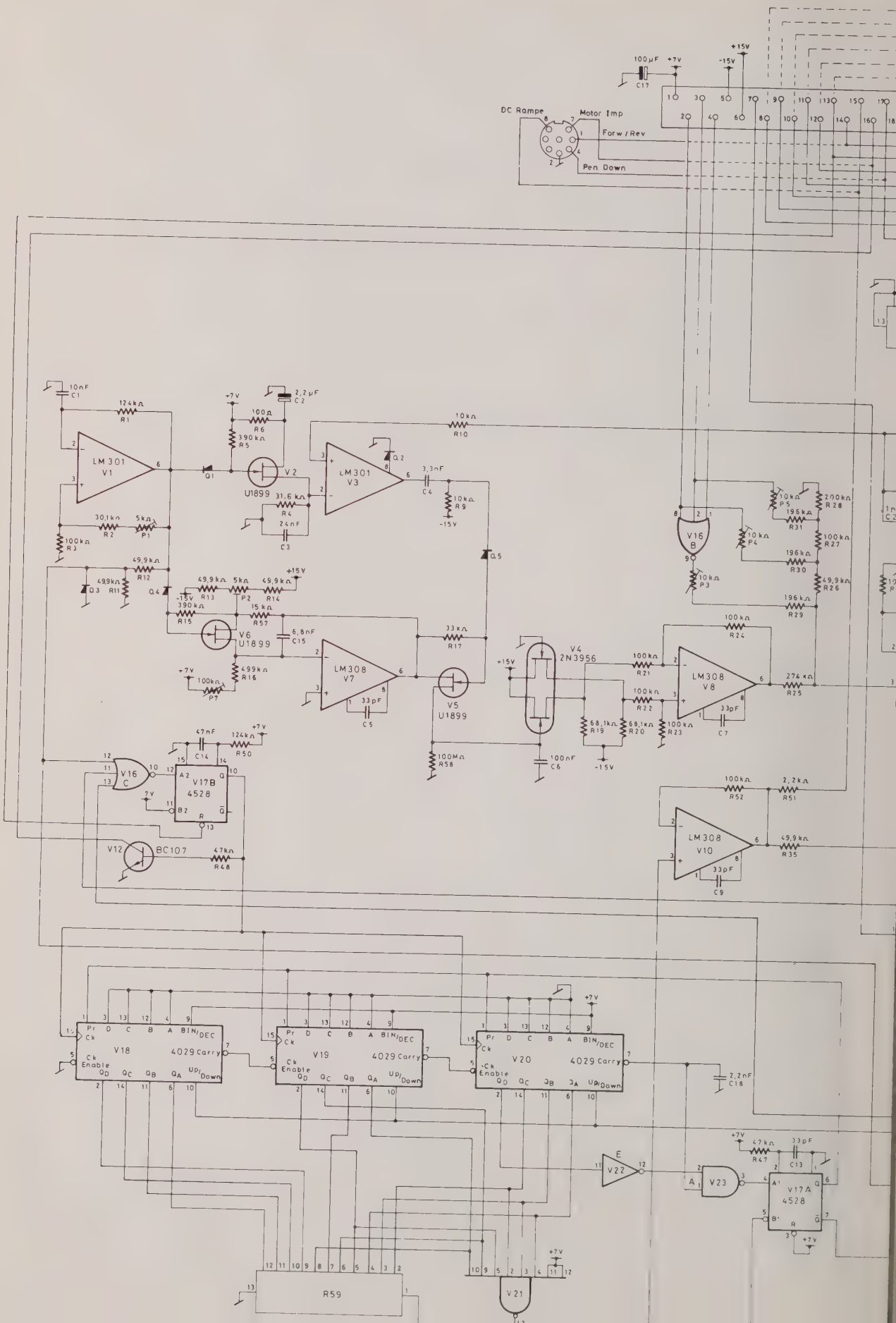


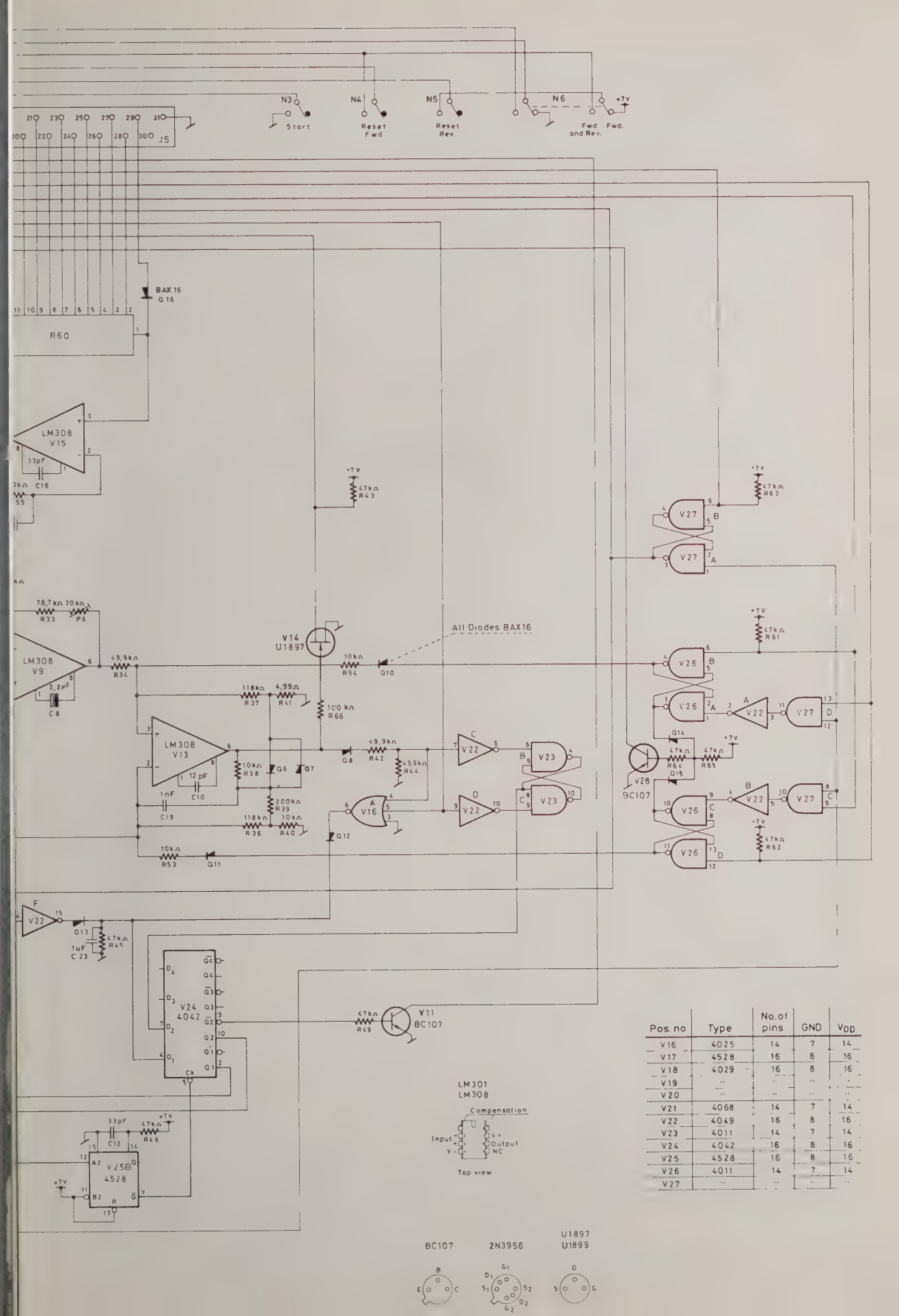
Viewed from the component side

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
C 1	Polystyrene			10 nF/ 63 V	CT 1545
C 2	Tantalum			2,2 µF/ 35 V	CF 0022
C 3	Polystyrene			24 nF/ 63 V	CT 1540
C 4	-			3,3 nF/ 30 V	CT 1544
C 5	Ceramic			33 pF/400 V	CK 1330
C 6	Polyester			100 nF/250 V	CS 0402
C 7	Ceramic			33 pF/400 V	CK 1330
C 8	-			2,2 nF/400 V	CK 3221
C 9	-			33 pF/400 V	CK 1330
C 10	-			12 pF/400 V	CK 1120
C 12,13	-			33 pF/400 V	CK 1330
C 14	Polyester			47 nF/250 V	CS 0401
C 15	Ceramic			6,8 nF/ 63 V	CT 1511
C 16	-			33 pF/400 V	CK 1330
C 17	Electrolytic			100 µF/ 16 V	CE 0310
C 18	Ceramic			2,2 nF/400 V	CK 3221
C 19	-			1 nF/400 V	CK 3101
C 20	-			2,2 nF/400 V	CK 3221
C 22	Ceramic			1 nF/400 V	CK 3101
C 23	Tantalum			1 µF/ 35 V	CF 0062
J 5	31-pin Plug for circuit board				JP 3103
P 1,2	Cermet		1/2 W	5 kΩ	PG 2520
P 3-5	-		-	10 kΩ	PG 3121
P 6	-		3/4 W	20 kΩ	PG 3209
P 7	-		1/2 W	100 kΩ	PG 4112
Q 1-8	Si.	BAX16		150 V/300 mA	QV 0217
Q 10-16	-	-		150 V/300 mA	QV 0217
R 1	Metal	1/4 W	1%	124 kΩ	RF 5124
R 2	-	-	-	30,1 kΩ	RF 4301
R 3	-	-	-	100 kΩ	RF 5100
R 4	-	-	-	31,6 kΩ	RF 4316

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 5	Carbon	1/4 W	5%	390 kΩ	RB 5390
R 6	-	-	-	100 Ω	RB 2100
R 9	-	-	-	10 kΩ	RB 4100
R 10	Metal	-	1%	10 kΩ	RF 4100
R 11-14	-	-	-	49,9 kΩ	RF 4499
R 15	Carbon	-	5%	390 kΩ	RB 5390
R 16	Metal	-	1%	499 kΩ	RF 5499
R 17	Carbon	-	5%	33 kΩ	RB 4330
R 19,20	Metal	-	1%	68,1 kΩ	RF 4681
R 21-24	-	-	-	100 kΩ	RF 5100
R 25	-	-	-	274 kΩ	RF 5274
R 26	-	-	-	49,9 kΩ	RF 4499
R 27	-	-	-	100 kΩ	RF 5100
R 28	-	-	-	200 kΩ	RF 5200
R 29-31	-	-	-	196 kΩ	RF 5196
R 32	-	-	-	100 kΩ	RF 5100
R 33	-	-	-	78,7 kΩ	RF 4787
R 34,35	-	-	-	49,9 kΩ	RF 4499
R 36,37	-	-	-	118 kΩ	RF 5118
R 38	-	-	-	10 kΩ	RF 4100
R 39	-	-	-	200 kΩ	RF 5200
R 40	-	-	-	10 kΩ	RF 4100
R 41	-	-	-	4,99 Ω	RF 0499
R 42	-	-	-	49,9 kΩ	RF 4499
R 43	Carbon	-	5%	47 kΩ	RB 4470
R 44	Metal	-	1%	49,9 kΩ	RF 4499
R 45-49	Carbon	-	5%	47 kΩ	RB 4470
R 50	Metal	-	1%	124 kΩ	RF 5124
R 51	Carbon	-	5%	2,2 kΩ	RB 3220
R 52	Metal	-	1%	100 kΩ	RF 5100
R 53,54	Carbon	-	5%	10 kΩ	RB 4100
R 55	Metal	-	1%	100 kΩ	RF 5100
R 57	-	-	-	15 kΩ	RF 4150
R 58	Carbon	1/8 W	20%	100 MΩ	RH 0901
R 59,60	Thick Film Circuit				RZ 0040
R 61-65	Carbon	1/4 W	5%	47 kΩ	RB 4470
R 66	-	-	-	100 kΩ	RB 5100

ZD 0163


DC Rampe
Motor Imp
Forw / Rev
Pen Down
LM 301
V1
LM 301
V3
LM308
V7
LM308
V8
LM308
V10
V2
U1899
V5
U1899
V6
U1899
V4
2N3956
V12
BC107
V16
V17B
4528
V17A
4528
V18
4029 Carry
V19
4029 Carry
V20
4029 Carry
V21
V22
V23
R59

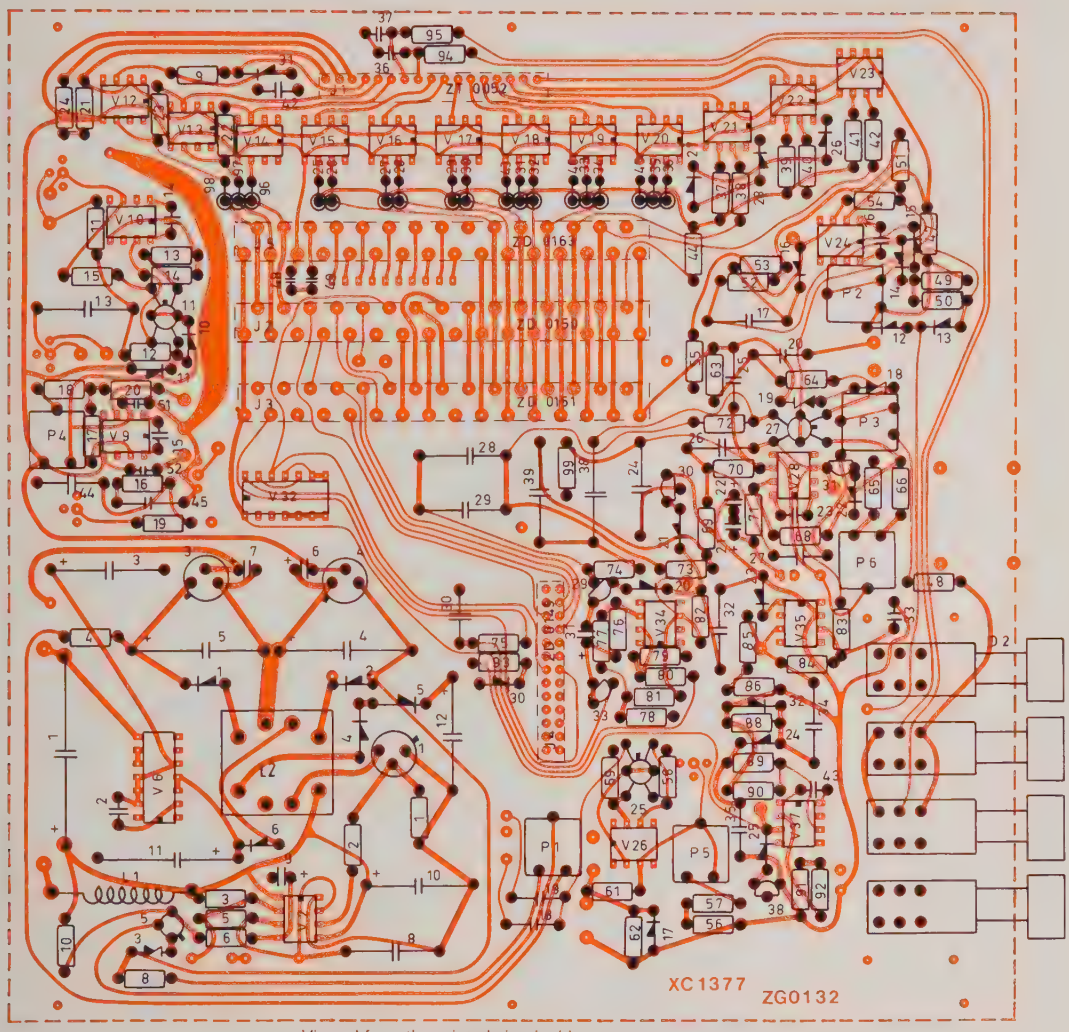


Pos. no	Type	No. of pins	GND	V_{DD}
V16	4025	14	7	14
V17	4528	16	8	16
V18	4029	16	8	16
V19	"	"	"	"
V20	"	"	"	"
V21	4068	14	7	14
V22	4049	16	8	16
V23	4011	14	7	14
V24	4042	16	8	16
V25	4528	16	8	16
V26	4011	14	7	14
V27	"	"	"	"

CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
V 1	Op. Amp.	LM301	VE 0017
V 2	FET N	U1899	VB 1064
V 3	Op. Amp.	LM301	VE 0017
V 4	FET N	2N3956	VB 1054
V 5,6	FET N	U1899	VB 1064
V 7-10	Op. Amp.	LM308	VE 0046
V 11,12	Silicon NPN	BC107	VB 1032
V 13	Op. Amp.	LM308	VE 0046
V 14	FET N Sel.	U1897	VB 1080
V 15	Op. Amp.	UM308	VE 0046
V 16	Tripple 3-input NOR	4025	VD 2015
V 17	Dual Monostable Multivibr.	4528	VD 2032
V 18-20	Preset U/D Counter	4029	VD 2018
V 21	Single 8-input NAND	4068	VD 2028
V 22	Hex Buffer Inverter	4049	VD 2024
V 23	Quad 2-input NAND	4011	VD 2004
V 24	Quad Clocked "D" Latch	4042	VD 2023
V 25	Dual Monostable Multivibr.	4528	VD 2032
V 26,27	Quad 2-input NAND	4011	VD 2004
V 28	Silicon NPN	BC107	VB 1032

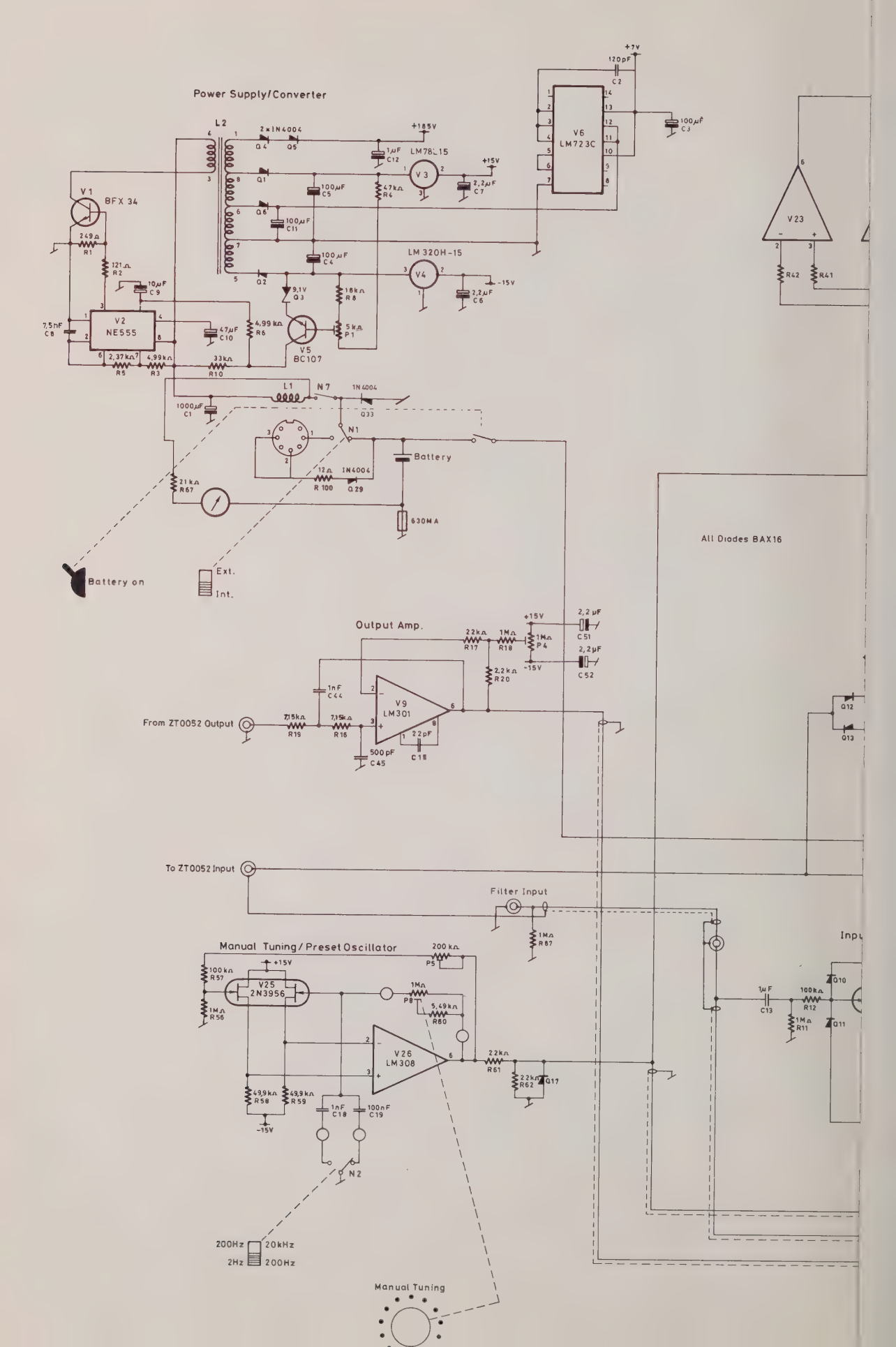
Printed Circuit Board	XC 1427
14-pin Socket for dual-in-line	JJ 1408
16-pin Socket for dual-in-line	JJ 1622

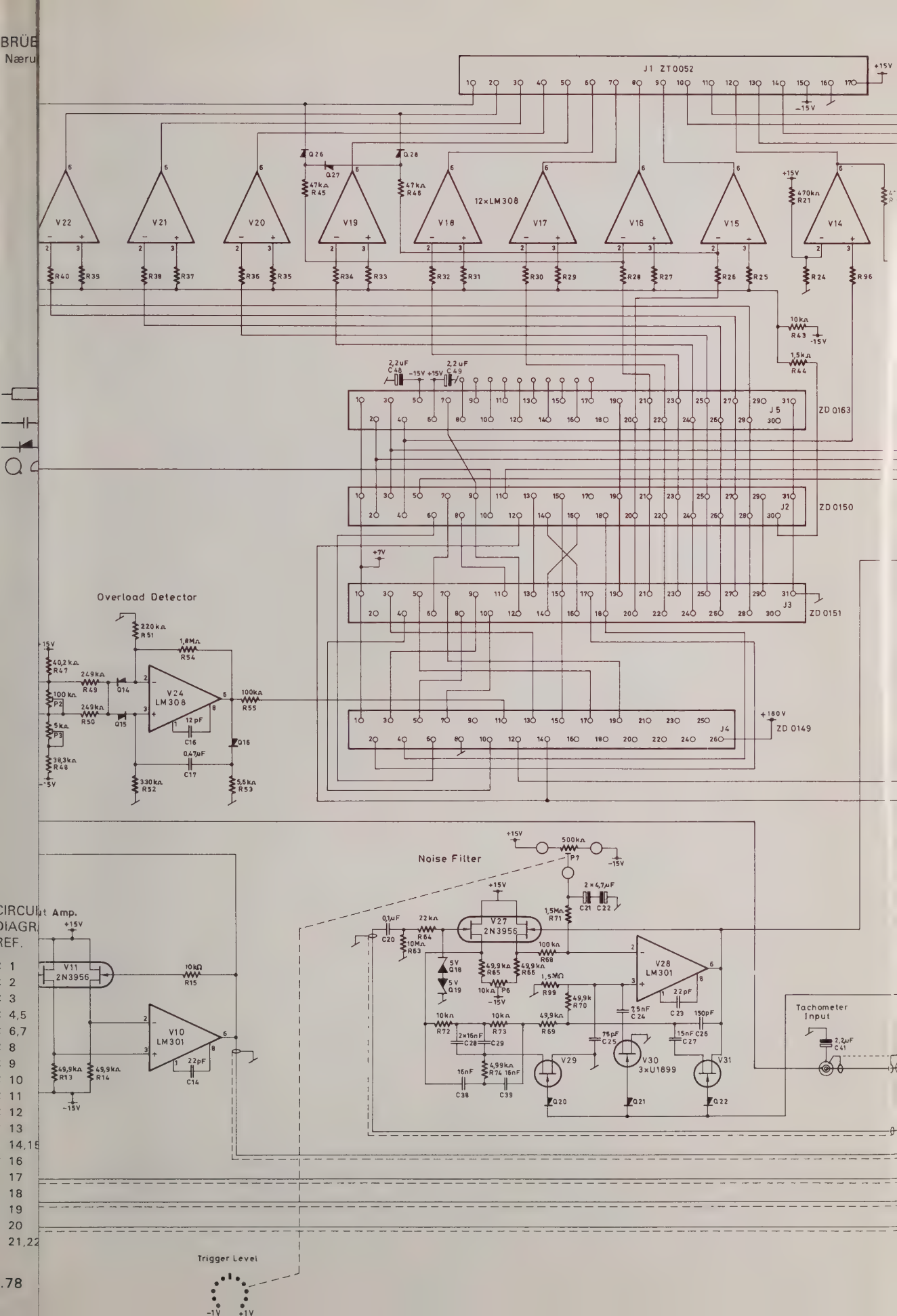
Circuit and Layout Diagram with Parts List

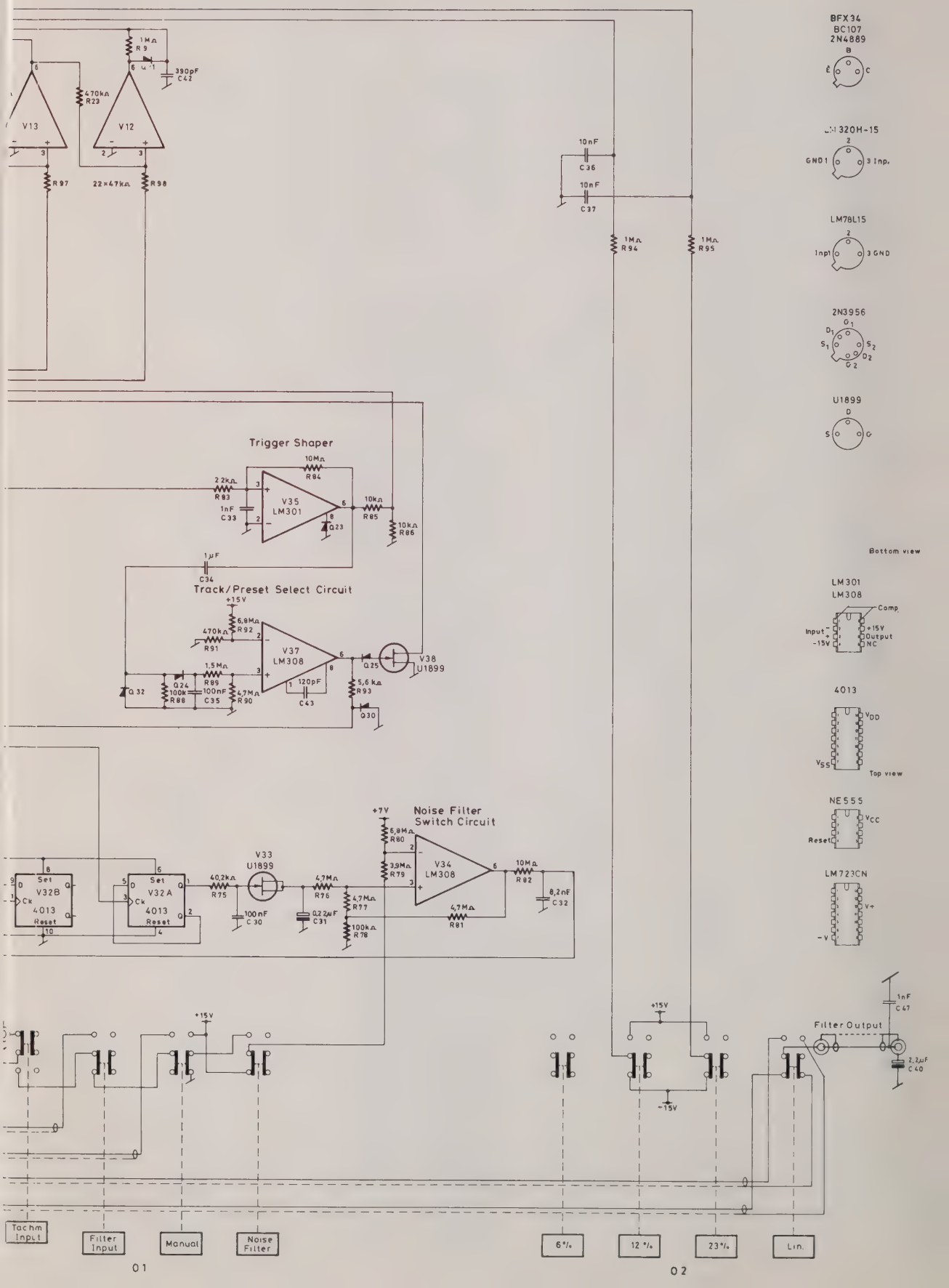


Viewed from the printed circuit side.

CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.	CIRCUIT DIAGRAM REF.	COMPONENT TYPE		STOCK REF.
C 1	Electrolytic	1000 µF/ 25 V	CE 0419	C 23	Ceramic	22 pF/400 V	CK 1220
C 2	Ceramic	120 pF/400 V	CK 2122	C 24	Polystyrene	7,5 nF/ 63 V	CT 1512
C 3	Electrolytic	100 µF/ 16 V	CE 0310	C 25	-	75 pF/125 V	CT 1128
C 4,5	-	100 µF/ 40 V	CE 0443	C 26	-	150 pF/400 V	CT 1139
C 6,7	Tantalum	2,2 µF/ 35 V	CF 0022	C 27	Polyester	15 nF/250 V	CS 0045
C 8	Polystyrene	7,5 nF/ 63 V	CT 1512	C 28,29	Polystyrene	16 nF/ 63 V	CT 1539
C 9	Tantalum	10 µF/ 35 V	CF 0064	C 30	Polyster	100 nF/250 V	CS 0402
C 10	Electrolytic	47 µF/ 40 V	CE 8965	C 31	Tantalum	0,22 µF/ 35 V	CF 0063
C 11	-	100 µF/ 40 V	CE 0443	C 32	Polystyrene	8,2 nF/ 63 V	CT 1556
C 12	-	1 µF/350 V	CE 0512	C 33	Ceramic	1 nF/400 V	CK 3101
C 13	Polycarbonate	1 µF/ 63 V	CS 0803	C 34	Polycarbonate	1 µF/100 V	CS 0384
C 14,15	Ceramic	22 pF/400 V	CK 1220	C 35	Polyester	100 nF/250 V	CS 0402
C 16	-	12 pF/400 V	CK 1120	C 36,37	Ceramic	10 nF/ 30 V	CK 4101
C 17	Polycarbonate	0,47 µF/100 V	CS 0383	C 38,39	Polystyrene	16 nF/ 63 V	CT 1539
C 18	Polystyrene	1 nF/ 63 V	CT 1132	C 42	Ceramic	390 nF/400 V	CK 2391
C 19	Polyester	100 nF/250 V	CS 0044	C 43	-	120 pF/400 V	CK 2122
C 20	-	0,1 µF/250 V	CS 0402	C 44	Polystyrene	1 nF/ 63 V	CT 1132
C 21,22	Tantalum	4,7 µF/ 35 V	CF 0051	C 45	-	500 pF/630 V	CT 0213
				ZG 0132 C 48-52	Tantalum	2,2 µF/ 35 V	CF 0022


Power Supply/Converter
L2
2x1N4004
Q4
Q5
+18.5V
1µF C12
LM78L15
V3
+15V
2,2µF C7
Q1
100µF C5
47kΩ R4
Q6
100µF C11
100µF C4
LM 320H-15
V4
-15V
2,2µF C6
Q2
9,1V Q3
18kΩ R8
V1 BFX 34
249Ω R1
121Ω R2
10µF C9
V2 NE555
7,5nF C8
47µF C10
4,99kΩ R6
5kΩ P1
V5 BC107
2,37kΩ R5
4,99kΩ R3
33kΩ R10
L1
N7
1N4004
Q33
1000µF C1
N1
Battery
12Ω R 100
1N4004 Q29
21kΩ R67
630MA
Battery on
Ext.
Int.
+7V
120pF C2
V6 LM723C
100µF C3
V23
R42
R41
All Diodes BAX16
Output Amp.
22kΩ R17
1MΩ R18
1MΩ P4
+15V
-15V
2,2µF C51
2,2µF C52
2,2kΩ R20
1nF C44
V9 LM301
22pF C11
500pF C45
From ZT0052 Output
7,15kΩ R19
7,15kΩ R16
Q12
Q13
To ZT0052 Input
Filter Input
1MΩ R87
Manual Tuning/Preset Oscillator
200kΩ P5
100kΩ R57
1MΩ R56
+15V
V25 2N3956
1MΩ P8
5,49kΩ R60
V26 LM308
22kΩ R61
22kΩ R62
Q17
43,9kΩ R58
43,9kΩ R59
1nF C18
100nF C19
-15V
N2
200Hz
20kHz
2Hz
200Hz
Manual Tuning
1µF C13
100kΩ R12
1MΩ R11
Q10
Q11


J1 ZT0052
+15V
-15V
12xLM308
V22
V21
V20
V19
V18
V17
V16
V15
V14
Q26
Q27
Q28
47kΩ R45
47kΩ R46
470kΩ R21
R40 R39 R38 R37 R36 R35 R34 R33 R32 R31 R30 R29 R28 R27 R26 R25 R24 R96
10kΩ R43
1,5kΩ R44
2,2uF C48
2,2uF C49
J5
ZD 0163
J2
ZD 0150
+7V
J3
ZD 0151
J4
+180V
ZD 0149
Overload Detector
220kΩ R51
1,8MΩ R54
40,2kΩ R47
249kΩ R49
100kΩ P2
249kΩ R50
5kΩ P3
38,3kΩ R48
Q14
Q15
Q16
V24 LM308
12 pF C16
0,47uF C17
330kΩ R52
5,6kΩ R53
100kΩ R55
Noise Filter
500kΩ P7
2x4,7uF C21 C22
1,5MΩ R71
V27 2N3956
0,1uF C20
22kΩ R64
10MΩ R63
100kΩ R68
5V Q18
5V Q19
49,9kΩ R65
49,9kΩ R66
10kΩ P6
1,5MΩ R99
49,9k R70
V28 LM301
22pF C23
7,5nF C24
150pF C23
10kΩ R72
10kΩ R73
49,9kΩ R69
2x16nF C28
4,99kΩ R74
16nF C38
16nF C39
75pF C25
15nF C27
15nF C26
V29
V30 3xU1899
V31
Q20
Q21
Q22
Tachometer Input
2,2uF C41
V11 2N3956
10kΩ R15
V10 LM301
22pF C14
49,9kΩ R13
49,9kΩ R14
Trigger Level
-1V
+1V


BFX34
BC107
2N4889
B
E
C
LM320H-15
2
GND 1
3 Inp.
LM78L15
2
Inp 1
3 GND
2N3956
G1
D1
S1
S2
D2
G2
U1899
D
S
G
Bottom view
LM301
LM308
Comp.
Input -
+
-15V
+15V
Output
NC
4013
VDD
VSS
Top view
NE555
Reset
VCC
LM723CN
V+
-V
Trigger Shaper
Track/Preset Select Circuit
Noise Filter
Switch Circuit
V13
V12
V35
LM301
V37
LM308
V34
LM308
V38
U1899
V33
U1899
V32B
4013
V32A
4013
R 97
22×47kΩ
R 98
470kΩ
R23
1MΩ
R 9
390pF
C42
10nF
C36
10nF
C37
1MΩ
R94
1MΩ
R95
10MΩ
R84
2.2kΩ
R83
1nF
C33
10kΩ
R85
10kΩ
R86
Q23
1µF
C34
6,8MΩ
R92
470kΩ
R91
1,5MΩ
R89
Q24
100k
R88
100nF
C35
4,7MΩ
R90
Q32
120pF
C43
5,6 kΩ
R93
Q25
Q30
+7V
6,8MΩ
R80
3,9MΩ
R79
10MΩ
R82
8,2nF
C32
40,2kΩ
R75
100nF
C30
4,7MΩ
R76
0,22µF
C31
4,7MΩ
R77
100kΩ
R78
47MΩ
R81
+15V
-15V
1nF
C47
Filter Output
2,2µF
C40
Tachm Input
Filter Input
Manual
Noise Filter
6 %
12 %
23 %
Lin.
01
02

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
J 1	17-pin Socket				JJ 1701
J 2,3	31-pin Socket				JJ 3105
J 4	26-pin Plug				JP 2603
J 5	31-pin Socket				JJ 3105
L 1	Converter Coil				LJ 0015
L 2	Coil				LB 0897
O 2	"Bandwidth"				OJ 0058
P 1	Cermet	1/2 W		5 kΩ	PG 2521
P 2	-	-		100 kΩ	PG 4113
P 3	-	-		5 kΩ	PG 2521
P 4	-	-		1 MΩ	PG 5112
P 5	-			200 kΩ	PG 4208
P 6	-	-		10 kΩ	PG 3122
Q 1,2	Si.	BAX16		150 V/300 mA	QV 0217
Q 3	Ze.	ZF9,1		8,5-9,6 V/0,25 W	QV 1109
Q 4,5	Si.	1N4001		400 V/1 A	QV 0237
Q 6-17	Si.	BAX16		150 V/300 mA	QV 0217
Q 18,19	Ze.	BZX83		5,3-5,9 V/0,25 W	QV 1105
Q 20-32	Si.	BAX16		150 V/300 mA	QV 0217
R 1	Metal	1/4 W	1%	249 Ω	RF 2249
R 2	Carbon	-	5%	121 Ω	RF 2121
R 3	Metal	-	1%	4,99 kΩ	RF 3499
R 4	Carbon	-	5%	47 kΩ	RB 4470
R 5	Metal	-	1%	2,37 kΩ	RF 3237
R 6	-	-	-	4,99 kΩ	RF 3499
R 8	Carbon	-	5%	18 kΩ	RB 4180
R 9	-	-	-	1 MΩ	RB 6100
R 10	-	-	-	33 kΩ	RB 4330
R 11				1 MΩ	RB 6100
R 12	-	-	-	100 kΩ	RB 5100
R 13,14	Metal	-	1%	49,9 kΩ	RF 4499
R 15	Carbon	-	5%	10 kΩ	RB 4100
R 16	Metal	-	1%	7,15 kΩ	RF 3715
R 17	Carbon		5%	22 kΩ	RB 4220
R 18	-	-	-	1 MΩ	RB 6100
R 19	Metal	-	1%	7,15 kΩ	RF 3715
R 20	Carbon	-	5%	2,2 kΩ	RB 3220
R 21-23	-	-	-	470 kΩ	RB 5470
R 24-42	-	-	-	47 kΩ	RB 4470
R 43	-	-	-	10 kΩ	RB 4100
R 44	-	-	-	1,5 kΩ	RB 3150
R 45,46	-	-	-	47 kΩ	RB 4470
R 47	Metal	-	1%	40,2 kΩ	RF 4402
R 48	-	-	-	38,3 kΩ	RF 4383
R 49,50	-	-	-	249 kΩ	RF 5249
R 51	Carbon	-	5%	220 kΩ	RB 5220
R 52	-	-	-	330 kΩ	RB 5330
R 53	-	-	-	5,6 kΩ	RB 3560
R 54	-	-	-	1,8 MΩ	RB 6180
R 55	-	-	-	100 kΩ	RB 5100
R 56	Metal	-	1%	1 MΩ	RF 6100
R 57	-	-	-	100 kΩ	RF 5100
R 58,59	-	-	-	49,9 kΩ	RF 4499
R 61,62	Carbon	-	5%	22 kΩ	RB 4220
R 63	-	-	-	10 MΩ	RB 7100
R 64	-	-	-	22 kΩ	RB 4220
R 65,66	Metal		1%	49,9 kΩ	RF 4499

CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 68	Carbon	1/4 W	5%	100 kΩ	RB 5100
R 69,70	Metal	-	1%	49,9 kΩ	RF 4499
R 71	Carbon	-	5%	1,5 MΩ	RB 6150
R 72,73	Metal	-	1%	10 kΩ	RF 4100
R 74	-	-	-	4,99 kΩ	RF 3499
R 75	-	-	-	40,2 kΩ	RF 4402
R 76,77	Carbon	-	5%	4,7 MΩ	RB 6470
R 78	-	-	-	100 kΩ	RB 5100
R 79	-	-	-	3,9 MΩ	RB 6390
R 80	-	-	-	6,8 MΩ	RB 6680
R 81	-	-	-	4,7 MΩ	RB 6470
R 82	-	-	-	10 MΩ	RB 7100
R 83	-	-	-	2,2 kΩ	RB 3220
R 84	-	-	-	10 MΩ	RB 7100
R 85,86	-	-	-	10 kΩ	RB 4100
R 88	-	-	-	100 kΩ	RB 5100
R 89	-	-	-	1,5 MΩ	RB 6150
R 90	-	-	-	4,7 MΩ	RB 6470
R 91	-	-	-	470 kΩ	RB 5470
R 92	-	-	-	6,8 MΩ	RB 6680
R 93	-	-	-	5,6 kΩ	RB 3560
R 94,95	-	-	-	1 MΩ	RB 6100
R 96-98	-	-	-	47 kΩ	RB 4470
R 99	-	-	-	1,5 MΩ	RB 6150
V 1	Silicon		NPN	BFX34	VB 0559
V 2	Timer			NE555	VD 0062
V 3	+ 15 V Regulator			LM78L15	VE 0078
V 4	—40 V Regulator			LM320-15	VE 0066
V 5	Silicon		NPN	BC107	VB 0032
V 6	Pos. Volt. Reg.			LJ23	VE 0052
V 9,10	Op. Amp.			LM301	VE 0017
V 11	FET		N	2N3956	VB 1054
V 12-24	Op. Amp.			LM308	VE 0046
V 25	FET		N	2N3956	VB 1054
V 26	Op. Amp.			LM308	VE 0046
V 27	FET		N	2N3956	VB 1054
V 28	Op. Amp.			LM301	VE 0017
V 29-31	FET		N	U1899	VB 1064
V 32	Dual D Flip-Flop			4013	VD 2006
V 33	FET		N	U1899	VB 1065
V 34	Op. Amp.			LM308	VE 0046
V 35	Op. Amp.			LM301	VE 0017
V 37	Op. Amp.			LM308	VE 0046
V 38	FET		N	U1899	VB 1064

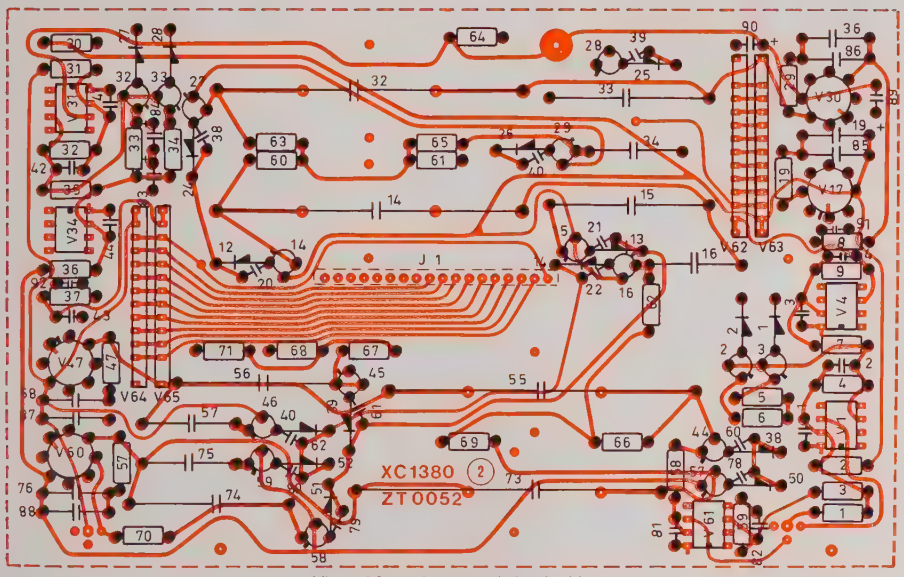
Printed Circuit Board	XC 1377
One-pole Plug	JJ 0060
8-pin Socket	JJ 0804
14-pin Socket	JJ 1408
One-pole Sokcet	JJ 0059

Components which are not included in ZG 0132 can be found on page 6—2

Circuit and Layout Diagram with Parts List

ZT 0052

Active Filter



Viewed from the printed circuit side

CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
C 1	Ceramic		120 pF/400 V	CK 2122
C 2	-		3,9 pF/400 V	CK 0390
C 3	-		120 pF/400 V	CK 2122
C 4	-		3,9 pF/400 V	CK 0390
C 14	Polystyrene	1%	1 µF/ 30 V	CT 1606
C 15	-	-	100 nF/ 63 V	CT 1543
C 16	-	-	10 nF/ 63 V	CT 1545
C 19	-	-	620 pF/125 V	CT 1109
C 20-22	Ceramic		12 pF/400 V	CK 1120
C 32	Polystyrene	1%	1 µF/ 30 V	CT 1606
C 33	-	-	100 nF/ 63 V	CT 1543
C 34	-	-	10 nF/ 63 V	CT 1545
C 36	-	-	620 pF/125 V	CT 1109
C 38-40	Ceramic		12 pF/400 V	CK 1120
C 41	-		120 pF/400 V	CK 2122
C 42,43	-		3,9 pF/400 V	CK 0390
C 44	-		120 pF/400 V	CK 2122
C 55	Polystyrene	1%	1 µF/ 30 V	CT 1606
C 56	-	-	100 nF/ 63 V	CT 1543
C 57	-	-	10 nF/ 63 V	CT 1545
C 58	-	-	620 pF/125 V	CT 1109
C 60-62	Ceramic		12 pF/400 V	CK 1120
C 73	Polystyrene	1%	1 µF/ 30 V	CT 1606
C 74	-	-	100 nF/ 63 V	CT 1543
C 75	-	-	10 nF/ 63 V	CT 1545
C 76	-	-	620 pF/ 12 V	CT 1109
C 78-80	Ceramic		12 pF/400 V	CK 1120
C 81	-		120 pF/400 V	CK 2122
C 82	-		3,9 pF/400 V	CK 0390
C 83,84	Tantalum		4,7 µF/ 35 V	CF 0009
C 85-88	Polystyrene	1%	470 pF/125 V	CT 1111
C 89,90	Tantalum		4,7 µF/ 35 V	CF 0009
C 91,92	Ceramic		1,5 pF/400 V	CK 0150

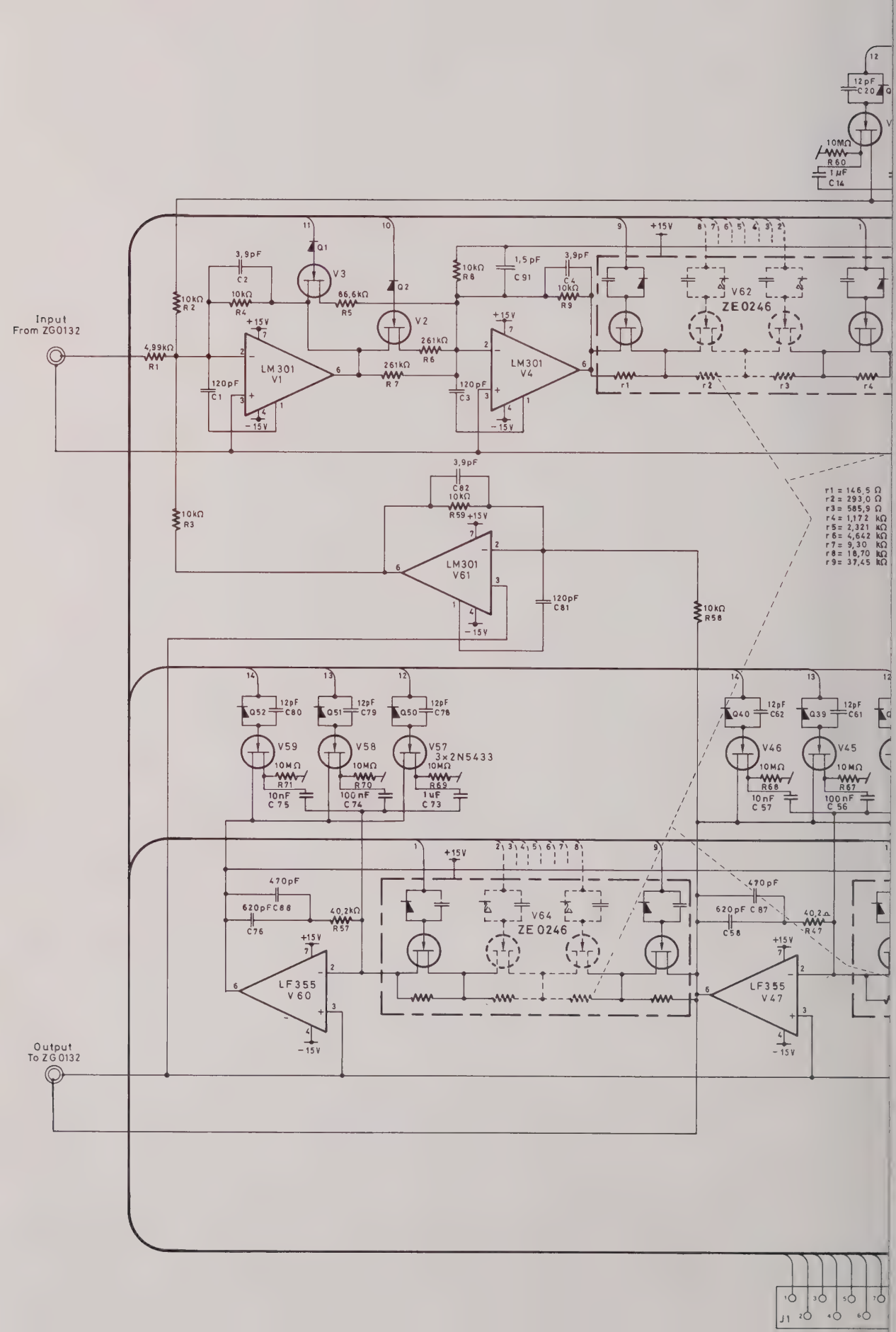
CIRCUIT DIAGRAM REF.	COMPONENT TYPE				STOCK REF.
R 1	Metal	1/4 W	1%	4,99 kΩ	RF 3499
R 2-4	-	-	-	10 kΩ	RF 4100
R 5	-	-	-	86,6 kΩ	RF 4866
R 6,7	-	-	-	261 kΩ	RF 5261
R 8,9	-	-	-	10 kΩ	RF 4100
R 19	-	-	-	40,2 Ω	RF 1402
R 29	-	-	-	40,2 Ω	RF 1402
R 30-32	-	-	-	10 kΩ	RF 4100
R 33	-	-	-	86,6 kΩ	RF 4866
R 34,35	-	-	-	261 kΩ	RF 5261
R 36,37	-	-	-	10 kΩ	RF 4100
R 47	-	-	-	40,2 Ω	RF 1402
R 57	-	-	-	40,2 Ω	RF 1402
R 58,59	-	-	-	10 kΩ	RF 4100
R 60-71	Carbon	-	5%	10 MΩ	RB 7100

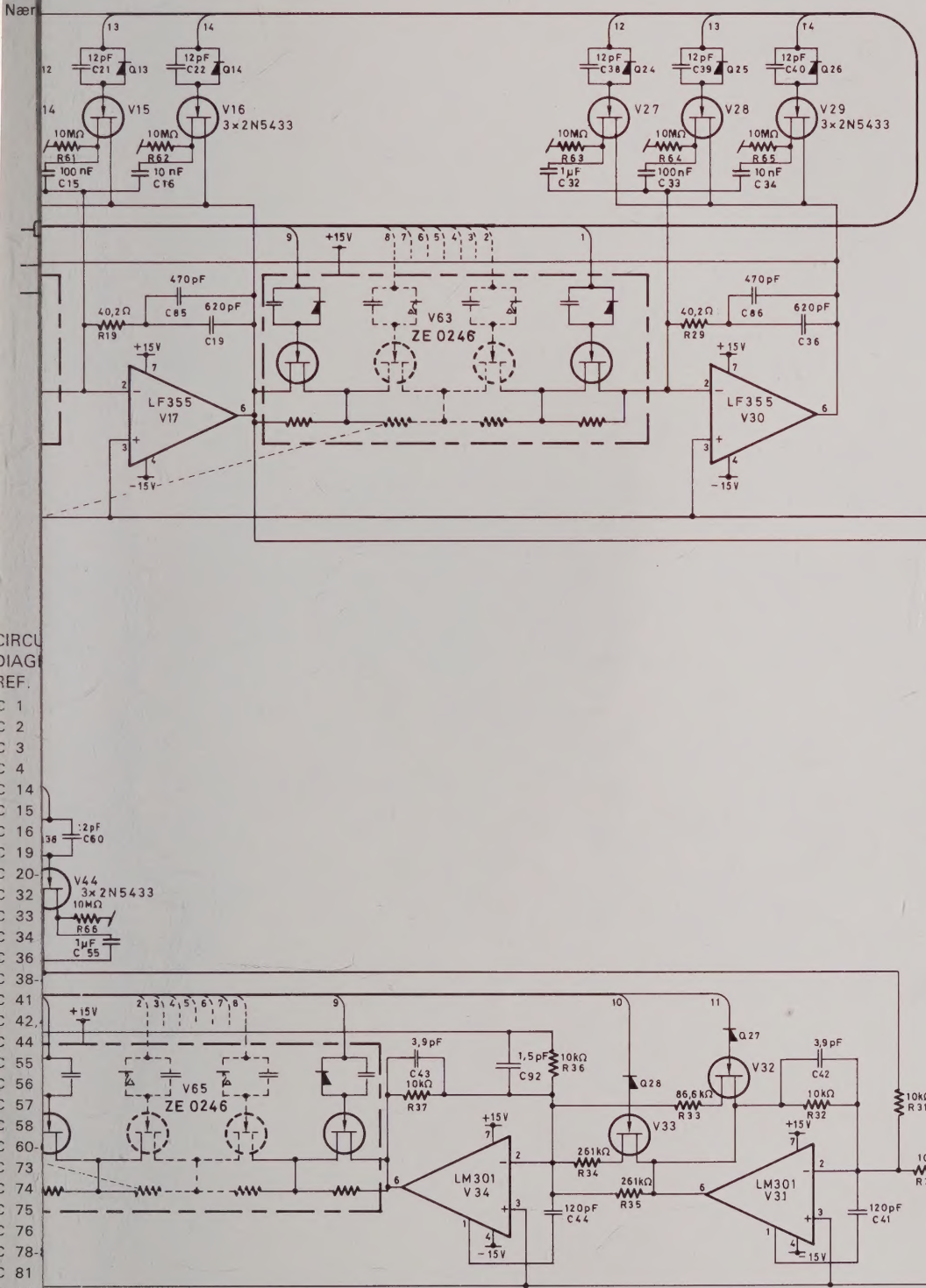
				STOCK REF.
V 1	Op. Amp.		LM301AN	VE 0017
V 2,3	FET N	sel.	U1897	VB 1080
V 4	Op. Amp.		LM301AN	VE 0017
V 14-16	FET N		2N5433	VB 1075
V 17	Amp.		LF355	VE 0107
V 27-29	FET N		2N5433	VB 1075
V 30	Amp.		LF355	VE 0107
V 31	Op. Amp.		LM301AN	VE 0017
V 32,33	FET N	sel.	U1897	VB 1080
V 34	Op. Amp.		LM301AN	VE 0017
V 44-46	FET N		2N5433	VB 1075
V 47	Amp.		LF355	VE 0107
V 57-59	FET N		2N5433	VB 1075
V 60	Amp.		LF355	VE 0107
V 61	Op. Amp.		LM301AN	VE 0017
V 62-65	Thick film circuit			ZE 0246

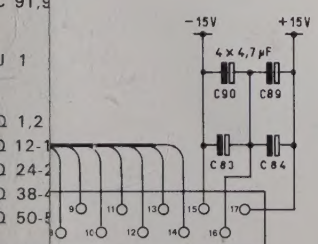
				STOCK REF.
J 1	17-pin socket			JJ 1701
			Printed Circuit Board	XC 1380
Q 1,2	Si.	BAX16	150 V/300 mA	QV 0217
Q 12-14	-	-	150 V/300 mA	QV 0217
Q 24-28	-	-	150 V/300 mA	QV 0217
Q 38-40	-	-	150 V/300 mA	QV 0217
Q 50-52	-	-	150 V/300 mA	QV 0217

One-pole Plug		JJ 0060
One-pole Socket		JJ 0059
8-pin Socket for dual-in-line		JJ 0804
8-pin Socket		JJ 0805
Metal Screen		GV 1477

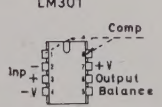
ZT 0052


Input
From ZG0132
Output
To ZG0132
LM301
V1
LM301
V4
LM301
V61
LF355
V60
LF355
V47
V62
ZE0246
V64
ZE0246
V3
V2
Q1
Q2
V59
V58
V57
3×2N5433
V46
V45
Q52
Q51
Q50
Q40
Q39
+15V
−15V
4,99kΩ R1
10kΩ R2
10kΩ R3
10kΩ R4
86,6kΩ R5
261kΩ R6
261kΩ R7
10kΩ R8
10kΩ R9
10kΩ R58
10kΩ R59
10MΩ R60
10MΩ R71
10MΩ R70
10MΩ R69
10MΩ R68
10MΩ R67
40,2kΩ R57
40,2Ω R47
1 µF C14
120pF C1
120pF C3
120pF C81
3,9pF C2
3,9pF C82
1,5pF C91
3,9pF C4
12pF C20
12pF C80
12pF C79
12pF C78
12pF C62
12pF C61
10nF C75
100nF C74
1uF C73
10nF C57
100nF C56
470pF C76
620pF C88
470pF C87
620pF C58
r1 = 146,5 Ω
r2 = 293,0 Ω
r3 = 585,9 Ω
r4 = 1,172 kΩ
r5 = 2,321 kΩ
r6 = 4,642 kΩ
r7 = 9,30 kΩ
r8 = 18,70 kΩ
r9 = 37,45 kΩ
J1





LM301



Top view

U1897
2N5433

Bottom view

LF 355